RUST ENVIRONMENT & INFRASTRUCTURE

FINAL
PROJECT ACTION PLAN
FORMER MACON NAVAL ORDNANCE PLANT

March 17, 1995

Prepared by
RUST ENVIRONMENT & INFRASTRUCTURE
Atlanta, Georgia

RUST E&I Project 32455.000
Document Control 32455-0010

Quality through teamwork

RUST ENVIRONMENT & INFRASTRUCTURE

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Quality through teamwork

3/17/95

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF TABLES

LIST OF APPENDICES

LIST OF ACRONYMS

amsl	above mean sea level
ACBM	asbestos containing building materials
ACM	asbestos containing materials
AST	Above Ground Storage Tank
ASTM	American Society for Testing and Materials
bls	below land surface
CERCLIS	Comprehensive Environmental Response, Compensation & Liability Information System
cm	centimeter
DERP/FUDS	Defense Environmental Restoration Plan/Formerly Used Defense Site
DIR	Draft Inventory Report
DNR	Department of Natural Resources
DOD	Department of Defense
EPA	Environmental Protection Agency
EPD	Environmental Protection Division
ESE	Environmental Science and Engineering, Inc.
FID	flame ionization detector
GDAP/QAP	Geotechnical Data Acquisition Plan and Quality Assurance Plan
GSA	Government Services Administration
H/T	hazardous and toxic
ID	inside diameter
LUST	leaking underground storage tank
MBCIA	Macon-Bibb County Industrial Authority
mg/L	milligrams per liter
MNOP	Macon Naval Ordnance Plant
NOV	Notices of Violation
OVA	organic vapor analyzer
PA	Preliminary Assessment Report
PAH	polycyclic aromatic hydrocarbons
PAP	Project Action Plan
PB&S	PB&S Chemical Corporation
PCBs	Polychlorinated biphenyls
PETN	pentaerythritoltetranitrate
PVC	polyvinyl chloride
RCRA	Resource Conservation Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RUST E&I	RUST Environment & Infrastructure
TCE	trichloroethene
TSCA	Toxic Substance Control Act
USACOE	U. S. Army Corps of Engineers
USGS	U. S. Geological Survey
UST	Underground Storage Tank
WEGS	Westinghouse Environmental and Geotechnical Services
WWTP	waste water treatment plant

EXECUTIVE SUMMARY

RUST Environment & Infrastructure has completed a research and limited geotechnical field sampling effort to develop a Project Action Plan for the former Macon Naval Ordnance Plant in Macon, Georgia. The purpose of this work was to prepare a comprehensive plan of action to address the contamination problems that resulted from operations during Department of Defense ownership of the plant.

The research effort included records reviews of federal, state, and local agencies, reviews of previously conducted environmental investigations, and interviews with regulators, landowners, the Corps of Engineers, and former employees. This review indicated the processes, methods, and materials used by the plant are possible sources of contamination. Previous studies have detected organic and inorganic contamination in the soil and groundwater at the site, and in surface water and sediments near the site.

The field geotechnical sampling effort included soil sampling from twelve borings spaced around the site. Soil samples were analyzed for grain-size distribution, Atterburg limits, and moisture content to evaluate the soil types at the site. Piezometers were installed in six of the twelve borings to measure water levels across the site. The hydrogeologic model developed for the site indicates that groundwater in the surficial aquifer flows to the south and southeast, with eventual discharge into Rocky Creek, which borders the investigated area on the south.

The site was divided into two separate study areas for further investigation. The probable migration pathways, and exposure routes for a preliminary list of contaminants of concern were evaluated for each study area. A field sampling plan was developed for each study area which will evaluate the most likely on-site and off-site sources of contamination. Additional hydrogeologic investigation is also recommended to more completely define the surficial aquifer. The results of these additional investigations will determine the regulatory status of the study areas and establish what, if any, remedial actions will be necessary.

1.0 INTRODUCTION

1.1 PURPOSE

The Savannah District of the United States Army Corps of Engineers (USACOE) has contracted RUST Environment & Infrastructure (RUST E&I) to prepare a Project Action Plan (PAP) for the former Macon Naval Ordnance Plant (MNOP) in Macon, Georgia. This work was initiated by the Savannah District under the Defense Environmental Restoration Plan/Formerly Used Defense Site (DERP/FUDS) program. The purpose of this project is to prepare a comprehensive plan of action to address possible contamination problems from MNOP operations during Department of Defense ownership. This PAP is submitted in accordance with the project scope of work.

1.2 RESEARCH

RUST E&I used personal interviews, records review, and site reconnaissance to develop the PAP for MNOP. The Document Search Report (RUST E&I, August 1994) listed the knowledgeable personnel interviewed and the public records sources consulted. The site reconnaissance portion of the research consists of a compilation of visual observations during other field work at the subject site and three site visits conducted specifically for the purpose of observing and photographing the site as directed by Section 2.2.6.1 of the *Scope of Work for Preparation of Project Action Plan at MNOP*, by USACOE Savannah District. The photographs were taken over a period of three days, October 21, 26, and 28, 1994. There are 126 photographs on file. Copies have been provided to the USACOE. Much of the information had previously been reviewed by USACOE and discussed in a 1990 report by Environmental Science and Engineering, Inc. (ESE, 1990). The information in Section 1.5.2 of this report provides an overview of the nature of operations at the MNOP. While reviewing and attempting to verify the historic information provided, RUST E&I concentrated on establishing verifiable details of the daily operations of the facility that exhibited potential for impact on current environmental conditions.

1.3 ORGANIZATION

The Project Action Plan is organized into the following chapters:

1.0 INTRODUCTION
2.0 HYDROGEOLOGIC CONCEPTUAL MODEL
3.0 ENVIRONMENTAL CONDITIONS
4.0 INDUSTRIAL PARK STUDY AREA

5.0 LANDFILL STUDY AREA
6.0 CONCLUSIONS AND RECOMMENDATIONS

The first three chapters of this report cover the topics with respect to the entire MNOP site. Chapters 4.0 and 5.0 contain discussions of topics specific to the areas within the MNOP property which have been determined to exhibit a potential for being contaminated by activities conducted during Department of Defense ownership of the MNOP. These two chapters also present information on the specific areas' potential exposure pathways, contaminants of concern, and action requirements of applicable regulations. These chapters will also describe any necessary field investigation activities and conclude with a schedule for these activities. Conclusions will be presented, and recommendations will be provided in Chapter 6.0.

1.4 SITE DESCRIPTION

The following description and information about the site was provided by the Savannah District of the Corps of Engineers in the scope of work for this project and was obtained during the site visit conducted on March 8, 1994. Subsequent research by RUST E&I reviewed and validated that information which is described in this section. Additional and more detailed information derived from RUST E&I research is presented in subsequent sections of this report. The subsequent sections describe the hydrogeologic, historical, and current site conditions of the MNOP.

The MNOP site is in Bibb County on the south side of Macon, Georgia. It is east of U.S. Highway 129 (Business) on Guy Paine Road. The site occupies just over 430 acres. It is bordered to the west and southeast by large industrial facilities, to the north by light industrial facilities, and to the south by the flood plain of Rocky Creek (Figure 1-1).

The MNOP was constructed and operated by the Reynolds Corporation prior to World War II. The Navy assumed operations in 1941 and continued production of ordnance until 1965. Items manufactured included flares, small primers, detonators, and other triggering mechanisms. Construction at the MNOP facility included numerous buildings, paved roads, underground storage tanks, solvent storage buildings, an oil collection pad, munitions bunkers, and a sewage treatment plant. During Department of Defense occupancy, wastes were disposed of in a 12 to 15 acre landfill located in the southwest corner of the site. A burn pit area was located in the same general area and used for explosives testing and disposal of flammable waste.

The property was sold in December, 1965 to the Maxson Electronics Company of New York. Maxson subsequently sold the property to Allied Chemical Corporation in 1973. It is reported that Allied made beneficial use of all or nearly all of the buildings, underground storage tanks,

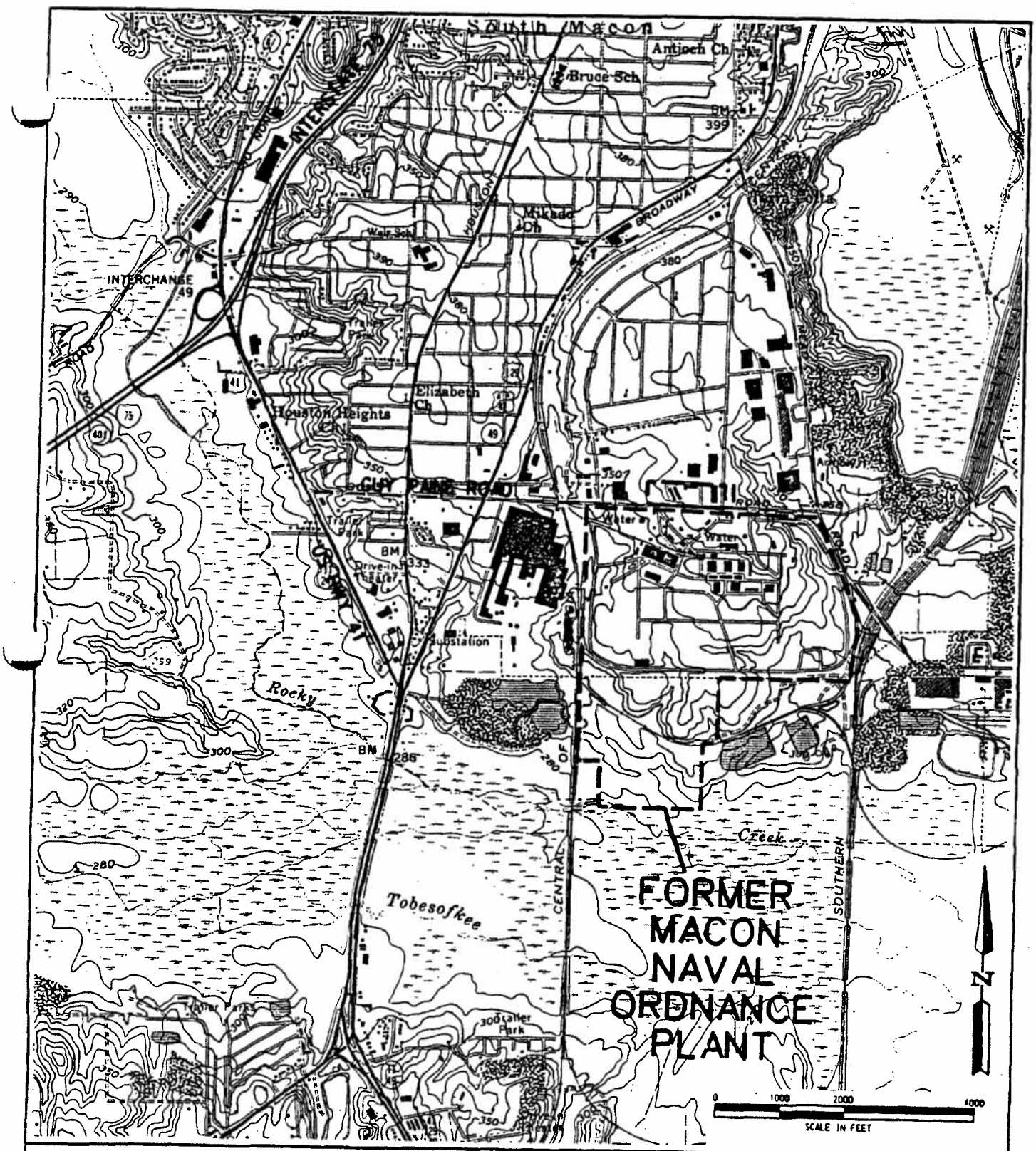

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FIGURE 1-1
SITE LOCATION MAP
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA
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32455017 12/94

and utilities. Allied sold the property in 1980 to the present owners, the Macon-Bibb County Industrial Authority (MBCIA).

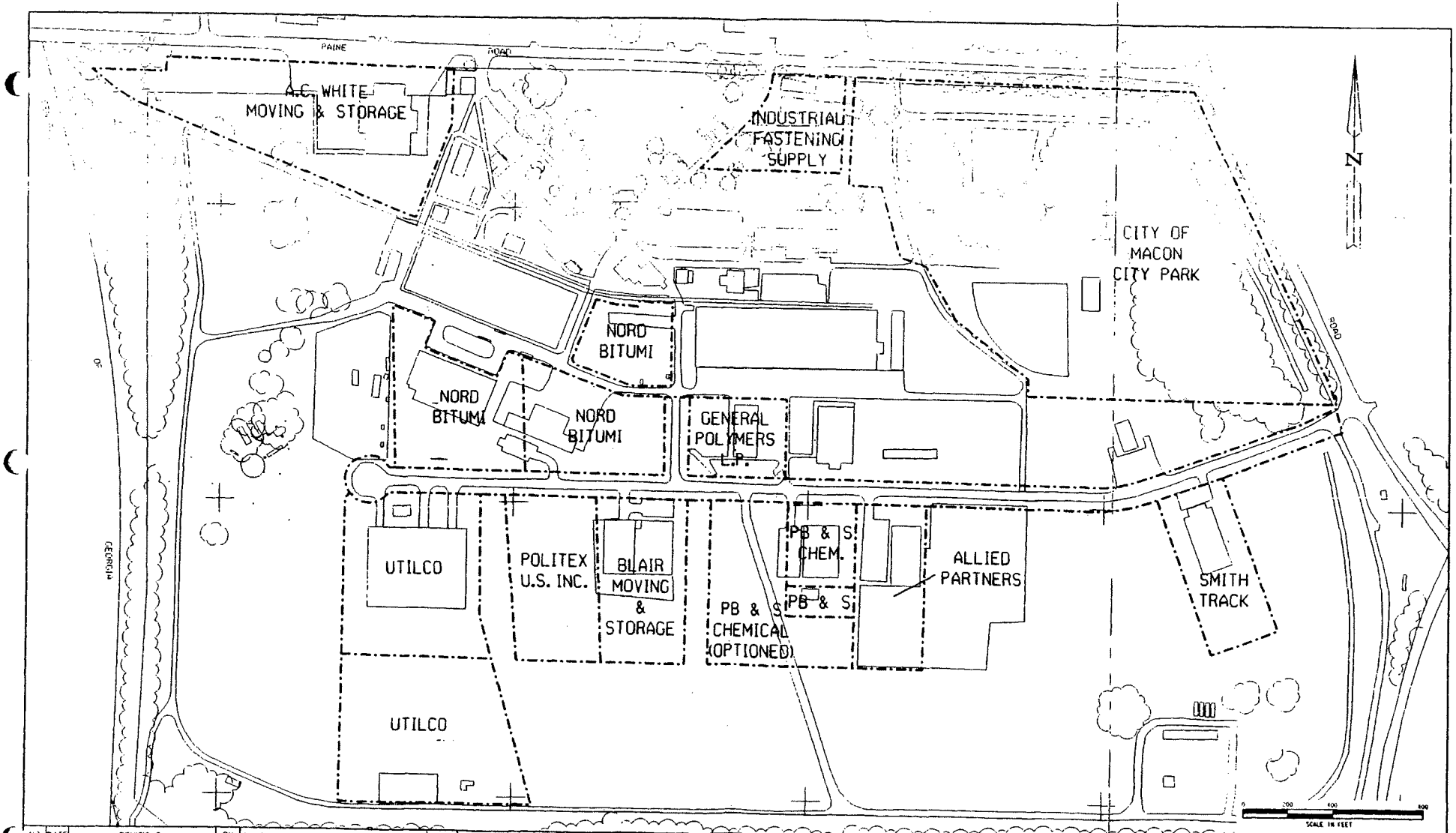
The site is currently known as the Macon-Bibb County Allied Industrial Park. Many of the buildings originally built for the Navy and later used and/or renovated by either Maxson or Allied Corporation are currently in use by the MBCIA as lease property. The MBCIA leases these buildings as office and warehouse space to various industrial and commercial tenants. As shown in Table 1-1, the leasees vary widely in their business lines, but most are light industrial, bulk storage, foodstuffs distributors, or moderate manufacturing facilities.

Some of the industrial park property, primarily that on the south side of Allied Industrial Boulevard, has been sold for industrial development. At present, there are eleven other owners of property within the industrial park, who have purchased tracts from the MBCIA. The various owners and their respective properties are shown in Figure 1-2. The northeast corner of the site has been obtained by the city of Macon for recreational purposes (ballfields and a pool). Ownership of a portion of the property which contains the landfill and burn pit described above has been transferred to the Macon Water Authority.

The main roads and most of the larger primary buildings from the MNOP remain intact. Alterations have been made in some of the buildings, and many of the smaller out-buildings and all the explosives bunkers have been removed. Allied Industrial Boulevard was constructed to run east and west at approximately the midpoint of the MNOP. The old perimeter road circling the MNOP was cut at approximately 350 feet north of the old G-7 guard house, and Allied Industrial Boulevard was constructed to connect to Mead Road. Allied Industrial Boulevard is a two-lane road, which crosses the Allied Industrial Park in an east-west line south of the 106-108 buildings and proceeds to a point south of Building 6 where it ends in a cul-de-sac. Most of the new construction within the industrial park has occurred along this road.

The new buildings are of typical warehouse/office combination construction. From exterior observations, they appear to be of metal frame and concrete block construction on slabs-on-grade. There are various exterior finishes, but most are some combination of brick and/or metal siding.

Most of the roadways for the Allied Industrial Park are those which were constructed as part of the MNOP. The perimeter road is intact and passable except for the southeast corner of the facility. The road is broken and impassable at the Allied Industrial Boulevard entrance to Allied Industrial Park as previously noted. The road is also blocked at the extreme southeast corner of the property just east of the former Dunnage Building/railroad spur where the road turns to the north. This stretch of the perimeter road is unused, grown-over, and breaking up in places.



NO	DATE	REVISIONS	BY

RUST PROJECT	32455.006	DATE
DESIGNED BY	B.HADDEN	1/95
DRAWN BY	M.PEARCE	1/95
CHECKED BY		
FILE NO.	32455024	

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FIGURE 1-2
ALLIED INDUSTRIAL PARK
SITE PROPERTY DISPOSITION
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

Table 1-1
Current Leasees
Allied Industrial Park

Tenant	Start Date	Building	Business Type
Architectural Precast	1989	Land Lease (3 Acres)	Precast Conc. Panels*
Lewis C. Baker	1987	3-A	Grounds Maintenance
Bakery, Conf. & Tob.	1988	30	Office Space
Bibb County	1981	105-D 108 60	Govt. Surplus Equip. Confiscated Cars, Excess Equip. Storage
Brewer's Bones	1994	2, Kitchen	Mfrg. of Dog Biscuits
Cable Constructors, Inc	1994	20	T.V. Cable Const. Office
Chamber of Commerce	1983	1	Records Storage
Cherry Blossom Festival	1993	9	Material Storage
Cornell Young	1989	9	Records Storage
Ellcott Mfg. Co.	1993	106 - East Side	Sheet Metal Fabrication
Eller Const. Co.	1995	Outside Storage	Utility Construction
Fastserv Medical of Macon	1993	7 1	Medical Equipment Reconditioning
Favreau Forge	1994	104	Ornamental Iron Fabricator
GA Stain. & Alloy	1987	2	Distributors of Stainless Steel
George Peake	1987	1-A	Records Storage

Table 1-1
Current Leasees
Allied Industrial Park

Tenant	Start Date	Building	Business Type
J&H Auto Service	1992	106	Neighborhood Auto Repair
Jones Piping, Inc.	1994	7-F	Irrigation Contractor
Keebler	1995	Land Lease (3-1/2 acres)	Excess Equipment Storage
Macon Discount Builders Materials	1994	5-C	Buildings Materials Warehouse
Mercer Eng. School	1992	1-A	Records Storage
Middle GA Consortium	1988	1-A	Records Storage
Middle Georgia Allied Warehousing, Inc.	1994	105-C	Trucking Warehouse
Mimbs Construction	1993	1	Equipment storage
National Nail	1993	106-A	Mfg., Pkg., Dstrbg. of Nails
Piedmont Marketing	1986	108 West	Equipment Storage
Police Precinct	1982	8	Macon Police Service
Proflex	1989	105-A & 105-A-1	Manufacturer of Rubber Straps
Quality Tech. Services	1993	106	Welding Machine Repair
Radio Macon, Inc.	1993	Land/3.68 Ac.	Transmission Tower
Raffield Tire	1988	105A 40	Office/Warehouse for Tire Dealer

Table 1-1
Current Leasees
Allied Industrial Park

Tenant	Start Date	Building	Business Type
Riverwood International	1992	5-B, 105-B, 5-A1, 5-B, 5-B1	Paper Product Storage (Rolls)
S.P.W. Industries	1988	3-C	Industrial Tire Service
Saffron, Inc.	1994	105-B-1, 105-C	Paper Coating Company Kaolin Production
T&K Machines	1990	5-A	Small Aircraft Machine shop
Thermodynamics (Also has 9,000 sq. ft. of open storage space.	1988	105-E, 105-C	Manufacturer of Plastic Pallets/Mats
Allied Enterprise Ctr.	1987	102	Small Business Incubator

* Not active for the last two years.
Source: Mr. Tom Yocum, Projects Manager, MBCIA - December 1994

Much of the concrete pathways which traversed the MNOP were demolished with the explosives bunkers. In the area south of Allied Industrial Boulevard, many of the pathways have been replaced with new construction. The primary north-south connector, besides the west perimeter road, runs between the approximate midpoints of Allied Industrial Boulevard and the south perimeter road. Almost all of the MNOP development in the northeast corner of the MNOP property has been removed and replaced with recreational facilities (ball fields) owned by the City of Macon. Building 109 is still in this area, and as noted, the perimeter road is intact here.

The primary alterations to MNOP buildings, discounting building interiors, involved Buildings 5 and 105. Both of these were originally clusters of closely aligned, but unconnected, buildings with the same numeric identification and different alphabetic designations. These unconnected buildings were connected during the time Allied Chemical operated the facility. The building connections were made by constructing metal frames between the original main structures. According to interviews, this was to facilitate more efficient assembly-line manufacturing processes.

1.5 SITE HISTORY

1.5.1 Ownership History

The public records reviewed indicated that the MNOP property was acquired by the Navy in three basic tracts from 1941 through 1960. It was then sold to Maxson Electronics Corporation in 1965, who in turn sold the facility to Allied Chemical Corporation in 1973. The Macon Bibb County Industrial Authority purchased the property from Allied in 1980 and began development of the facility into an industrial park. The only indication of ownership prior to the City of Macon, which sold the first tract to the Navy in 1941, exists in the environmental assessment report by Beaver Engineering for PB&S Chemical Corporation. This report indicates the portion of the site researched in their assessment was part of a family farm prior to the city's acquisition.

1.5.2 Operations History

The following information summarizes the operational history of the MNOP:

- The MNOP was operated by the Reynolds Corporation for the U.S. Navy, and it was originally called the Reynolds Corporation Fuse Loading Plant according to site and building plans reviewed at the MBCIA.

- Based on previous studies (ESE 1990; WEGS 1991; GA EPD 1992) and records of the Government Services Administration (GSA) on file at the Records Center of the National Archives in East Point, Georgia, the work at the MNOP involved the production, handling and storage of significant quantities of chemicals, explosive materials, solvents, and petroleum products.

- Based on information from interviews with Mr. Ralph Ennis, former director of Allied Industrial Park and former employee of MNOP, Maxson, and Allied; and Mr. Tom Yocum, current Projects Manager for MBCIA; and review of plant-wide facilities and utilities construction plans, areas of the MNOP which involved the production, storage, and handling of chemicals, explosives, solvents, and petroleum products are located throughout the property. Figure 1-3 provides an overall view of the MNOP property and the structures most directly associated with the above operations.

- Available records describe the MNOP waste characteristics in only general terms. The landfill is said to have received explosives and flammable wastes from DOD operations, but in interviews and previous studies (ESE 1990) the landfill wastes were indicated to be limited primarily to used parts and construction debris. Previous environmental sampling and analyses have detected contamination of both soil and groundwater at the MNOP.

- The progress of materials-handling at the MNOP, according to interviews with Messrs. Ennis and Yocum, was indicated to have proceeded generally from the southeast corner of the property to the production and storage areas in the north central part of the facility. Raw materials would enter at the southeast corner of the property from off the Central of Georgia rail line spur. The material would then proceed to the manufacturing areas of Building 5, or to the various blending/weighing areas (Structures 38-41). Drying buildings (Structures 55-60) or testing laboratories such as Building 7B might receive raw as well as finished products. Finished products would generally proceed to assembly buildings 106 through 109 or to other storage areas in Building 5 or Building 105. From assembly areas, as orders warranted, the ordnance would proceed to the out-bunkers or other storage (after 1964) in Building 198, prior to shipment from the MNOP via the northwest rail line on the north side of Buildings 5 and 105. Transport within the facility was via the paved paths and roadways which traversed the entire plant. A summary of general building usage is shown in Table 1-2. Plate No. 1 contains site plans with the most complete building locations discovered during this project research.

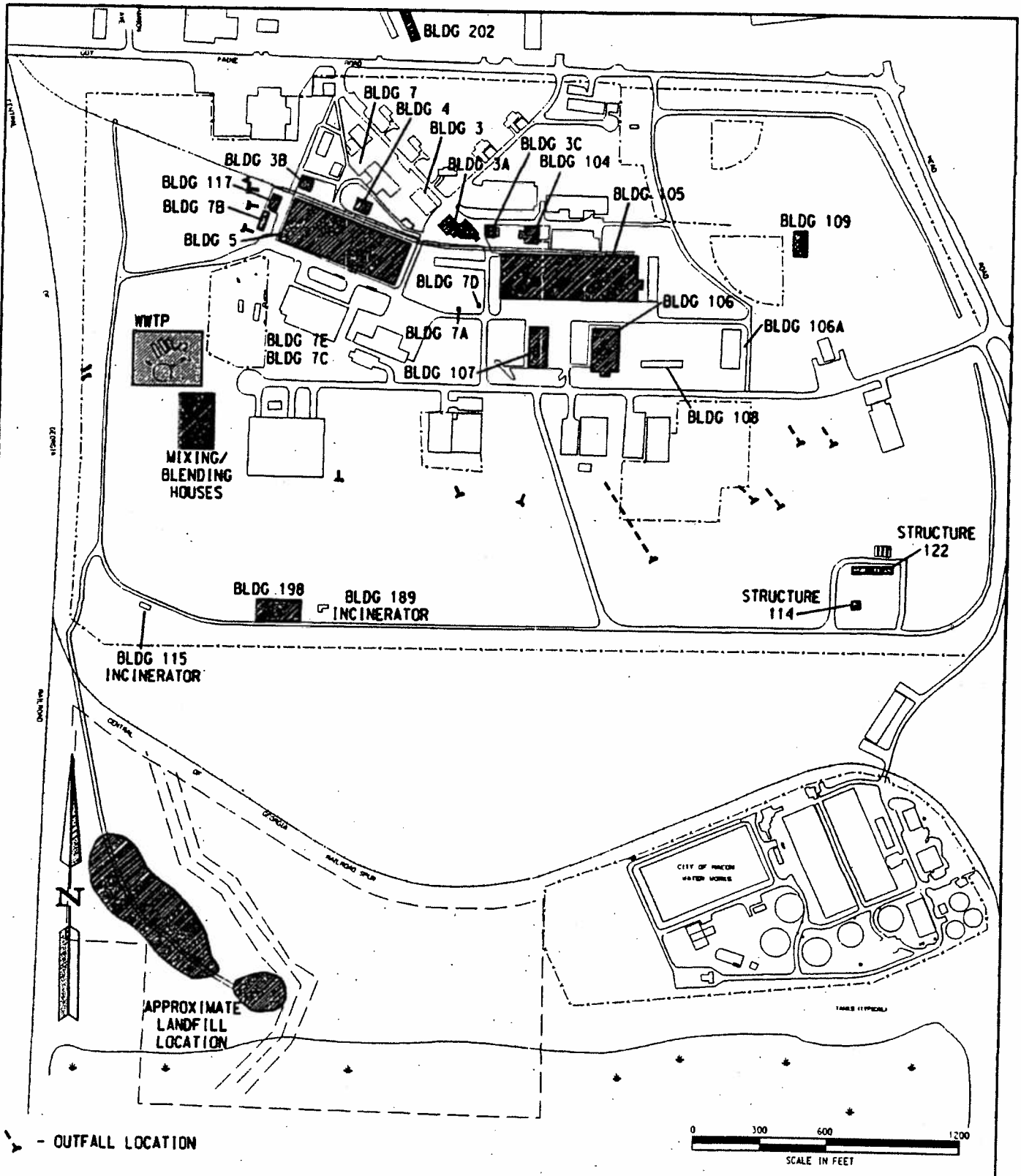

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FIGURE 1-3
PRIMARY OPERATIONS AREAS
(AREAS OF FURTHER STUDY)
FORMER NAVAL ORDNANCE PLANT
MACON, GEORGIA
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Table 1-2
General Structure Usage 1941-Present
Former Macon Naval Ordnance Plant

STRUCTURE NUMBER	MNOP USAGE	CURRENT USAGE/COMMENTS
1,1A, 1B	Administrative Offices	Office space
2	Cafeteria	Office space
3	Machine & Welding Shop	MBCIA lease
3A	Garage, Utility Shop & Fire Station	MBCIA lease
3B	Carpenter Shop	Vacant
3C	Paint Shop	MBCIA lease
4	Power House	Vacant
5A, 5B, 5C	Manufacturing	MBCIA lease
5D-5P	Storage	Removed
5Q	Drum Storage	Removed
6	Explosives Loading Building	MBCIA lease
7, 7A, 7B	Inspection Laboratory	7, 7B-Vacant, 7A-Removed
7C	Test House/Quality Control	Removed
7D	Linseed Oil Breakdown Building	Removed
7E	Test Firing House	Removed
7F	Electronics Laboratory	MBCIA lease
8	Guard HQ & Personnel Office	MBCIA lease
9	Medical Dispensary	MBCIA lease
10,115	Incinerator	Removed
11	Loading Platform	Present
21-27/31-37	Ordnance Magazines	Removed
38, 38A	Blending & Weighing House	Removed
39, 40, 41, 54	Pouring/Screening Building	Removed
42-53	Ordnance Magazine	Removed
55-59	Storage & Dryer Building	Removed
60, 61	Rumble House (Ordnance)	Removed
62, 63	Pre-mix House	Removed
64-67	Service House	Removed

Table 1-2
General Structure Usage 1941-Present
Former Macon Naval Ordnance Plant

STRUCTURE NUMBER	MNOP USAGE	CURRENT USAGE/COMMENTS
68	Storage & Equipment Shed	Removed
69	Magnesium & Aluminum Storage	Removed
70-74	Waste Water Treatment Plant	Vacant - unused
78	Reservoir & Swimming Pool	City of Macon Park
79, 118	Elevated Water Tank	Removed
82, 38, 35, 86, 87, 90, 92, 94, 95, 96, 100, 111, 186	Tunnel Vent Access, Storage, Smoke Stands, Administrative, etc.	Removed - Vacant - Unused
99, 175, 190-193	Solvent Building	Removed
101	Garbage House	Removed
102	Marine Barracks	MBCIA lease
103	Cooling Tower	Unused
104	Power House	MBCIA Lease
150A, B, C, D	Ordnance/Supply Store House	MBCIA lease
106, 106A	Assembly Building	MBCIA lease
107	Detonator Building	Vacant - Under Renovation
108	Pelleting Building	MBCIA lease
109	Assembly Building, Explosive Testing	Vacant - City of Macon Park
113	Drilling Building	Removed
114	Chemical Sampling Building	Removed
117	Metal Cutting Storage	Vacant - Unused
119	Pump House	Unused
120	Ambulance Shelter	Vacant
121	Truck Axle Scales	Removed
122	Dunnage Storage	Removed
201, 203-206	Storage Building	Removed - Property Sold
202	Bachelor Officer Quarters	Removed Property Sold
207	B.O.Q Garage	Removed Property Sold

Table 1-2
General Structure Usage 1941-Present
Former Macon Naval Ordnance Plant

STRUCTURE NUMBER	MNOP USAGE	CURRENT USAGE/COMMENTS
A-H	Officer Quarters	MBCIA lease - F, G, H - Removed - Property Sold
D-1 - D-21	Dryer Bolding	Removed
G-1 - G-10	Outer Guard House	Removed or vacant
123, 194	Transit Shed/Chemical	Between bldgs. 5A-5B (likely removed)
124, 151, 152, 154, 155	Flag Pole, Retaining Wall, Tennis Court, etc.	Removed or Unused
153	Drop Test Tower	Removed
156	Deep Well 265 Ft. Deep	Unused, not closed
157	Mineral Spirits Tank 4000 Gal.	Unused
158	Cutting Oil Tank 12,000 gallon	Unused
177-182	Earth Barricade	Removed or unused
183	250-gallon Kerosene UST	Unused
184	5600-gallon Diesel Fuel UST	Unused
185	2000-gallon Gasoline UST	Unused
187	Barbecue Grill	Removed
188	Water Treatment Facility (swim pool)	City of Macon Park
189	Explosives Disposal Furnace	Removed

References:
1) Site Plan dated 8/1/65 Department of the Navy U.S. Naval Ordnance Plant, Macon, GA.
2) Schedule A - Supplement to Report of Excess Real Property - Buildings, Structures Utilities and Miscellaneous Facilities (from Property Transfer Records).
3) Site Plan - U.S. Naval Ordnance Plant - Macon, GA Master shore Station Development Plan General Development Plan - conditions as of 30 June 54.

- The operations conducted at the plant during Department of Defense (DOD) ownership from 1941 to 1965 were largely the same as operations conducted by Maxson Electronics during their ownership from 1965 to 1973. Allied Chemical Corporation purchased the property in 1973 and operated a seat belt manufacturing plant until 1981 when the property was sold to the MBCIA.

- The Allied seat belt plant utilized much of the machining, tooling and manufacturing equipment of the former ordnance works. Some of the buildings were renovated to house more assembly line operations, and the Allied operation never used any explosives in their processes. The metal plating facilities were utilized for plating the seat belt buckles and other metal components of the Allied product. Chromium sludge was a by-product of this operation according to review of available files at the Environmental Protection Division of the Georgia Department of Natural Resources (Georgia EPD) and information from an interview of Mr. Ralph Ennis. No specific waste disposition records were discovered in the research conducted for this report. Mr. Ennis indicated that the sludge was, to his recollection, disposed of by a commercial hauler. Even though the site waste water treatment plant (WWTP) was considered for use in treating the chrome sludge, it was never used for that purpose by Allied, according to Mr. Ennis. Mr. Ennis indicated that the first year Allied had the MNOP facility, they were primarily involved with renovation and alteration of the facility, and produced very little. Mr. Ennis said that Allied purchased a Chevron Precipitator to treat the metal plating sludge, and the precipitator discharged into the sanitary sewer. The WWTP was last active in or about 1973, according to Mr. Ennis. Mr. Ennis recollected that it was about this time, as head of facility maintenance, he was directed to route all building drains associated with operations, to the sanitary sewer. Up until that time, some operations buildings' floor drains and some sinks were routed to the storm drain system.

- The site is currently operated by MBCIA as an industrial park, leasing and selling property to light to medium industrial and commercial operations.

2.0 HYDROGEOLOGIC CONCEPTUAL MODEL

2.1 FIELD INVESTIGATION METHODS

2.1.1 Objectives And Scope

One objective of this project was to acquire geologic and hydrogeologic information to develop a preliminary hydrogeologic conceptual model of the MNOP. This information included existing data and data collected during the field activities. Along with information gathered from other tasks, the model will provide the basis for future assessment of the nature and extent of contamination at the MNOP.

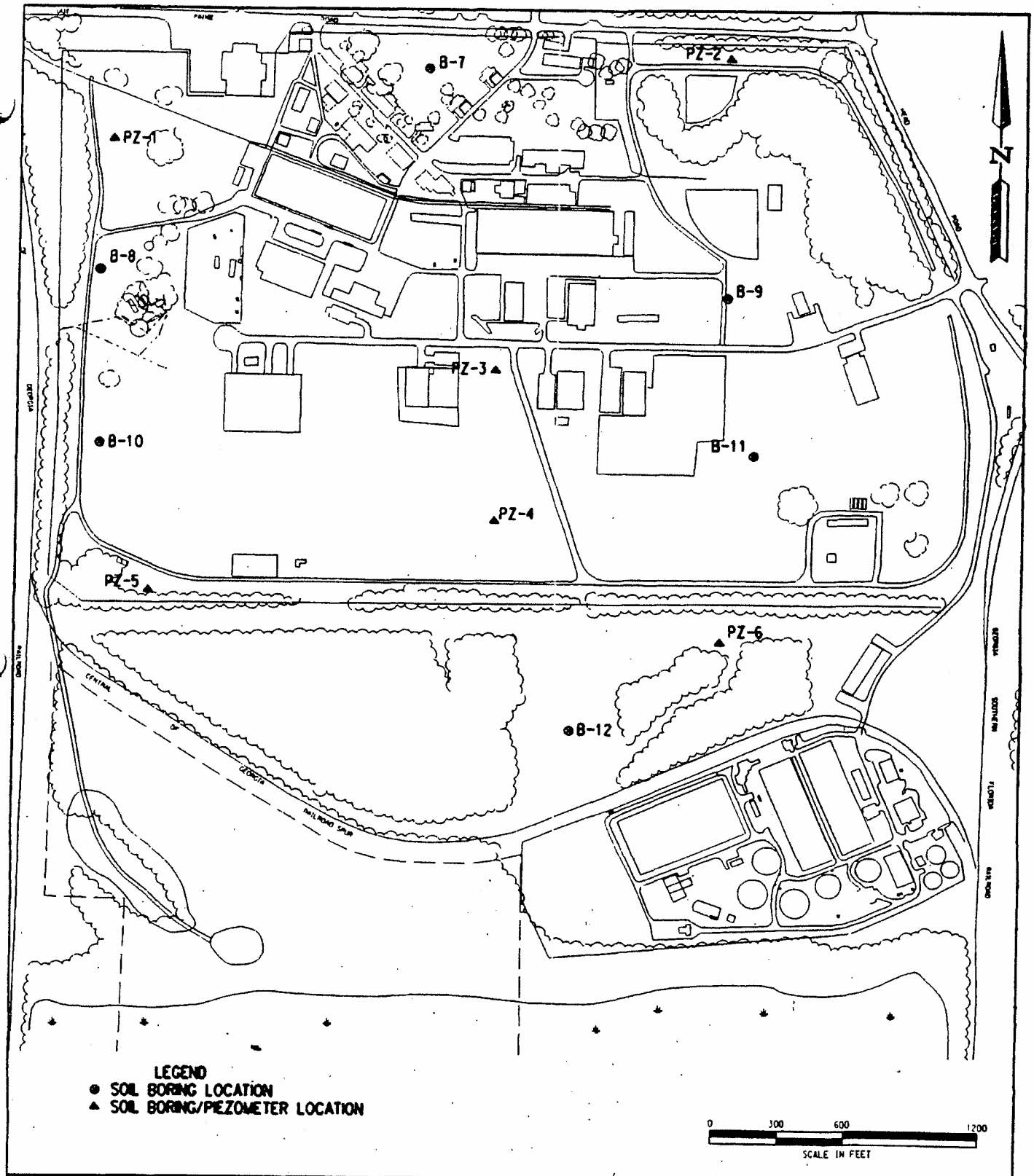
Information from existing published literature and previous investigations at the MNOP was reviewed and included in the development of the preliminary conceptual hydrogeologic model. Data gathered during field activities was used to develop hydrogeologic cross sections, determine groundwater flow direction, and establish hydraulic conductivity and linear velocity relationships within the surficial aquifer.

Field activities involved completing twelve soil borings at randomly spaced locations where soil was believed to be free of contamination. Soil borings ranged from 25 to 55 feet in depth. Representative samples were tested for grain-size distribution, Atterburg limits, and moisture content. Piezometers were installed in six of the twelve boring locations to measure the potentiometric surface of the surficial aquifer. Groundwater samples were also collected at these piezometers for field analyses of pH, specific conductivity, temperature, and dissolved oxygen. Hydraulic slug tests were performed at these piezometers to determine hydraulic conductivity.

2.1.2 Soil Borings

To help determine the geology of the site, twelve soil borings were advanced at randomly spaced locations throughout the site. Figure 2-1 shows the locations of the borings. Boring logs are provided in Appendix A. The well borings were advanced with a Mobile CME 75 drill rig using 4.25-inch inside diameter (ID) hollow stem augers.

Continuous split-spoon soil samples were collected and logged from all boring locations. The split-spoon was driven 24 inches into the soil by a 140-pound automatic hammer falling 30 inches (ASTM D-1586-67). Each split-spoon sample was described and logged by a geologist. Soil samples were collected from discrete intervals, placed in clean glass jars, covered with aluminum foil, and sealed with a screw on cap. After a period of at least 30 minutes, an organic vapor analyzer (OVA) (Foxboro Model OVA-128) equipped with a flame ionization detector



RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-1
PIEZOMETER/SOIL BORINGS LOCATION MAP
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA
RUST PROJECT 32455.000
32455019 12/94

(FID) was used to screen the headspace for organic vapors by pushing the OVA probe through the aluminum foil into the jar headspace. No indication of organic vapors was found in any of the soil samples analyzed using this method.

The soil samples were collected in areas not likely to contain any ordnance or hazardous materials. During field activities, all borings were air monitored using an OVA. The OVA was factory calibrated immediately prior to MNOP field operations. The OVA showed no detections above background levels throughout the entire field operation using continuous air monitoring.

Two soil samples were selected and labeled from each boring and piezometer location. These soil samples were collected in glass jars and sent to Analytical Services, Inc. (ASI) for testing of Atterburg limits, grain size distribution, and moisture content. Results are shown in Appendix A.

2.1.3 Piezometer Installation

To obtain an understanding of the groundwater hydrology, six piezometers were installed and screened in the upper portion of the uppermost water bearing zone. Figure 2-1 shows the locations of the piezometers. Schematics and subsurface drill logs are provided in Appendix A. The piezometer borings were advanced with a mobile CME 75 drill rig using 4.25-inch ID hollow stem augers. All piezometers were constructed with 2-inch diameter PVC materials, a 10-foot long section of 0.010-inch slotted screen, and a 6-inch sump. Construction summaries are shown in Table 2-1.

During piezometer construction, a commercially prepared, washed, silica sand was poured through the augers into the annular space around the screen to at least 2 feet above the top of the screen. To isolate the screened portion of the water bearing unit, a 4-foot seal of bentonite chips was placed above the sand pack. After the bentonite chips had sufficiently hydrated, the remaining annulus was tremie-grouted with a mixture of one 94-pound bag of Portland Type II cement to seven gallons of potable water and five pounds of bentonite powder. The piezometers were later developed by the hand bailing method. The procedure involved purging at least three volumes of water from the piezometer until relatively non-turbid water was produced. The purpose of development is to clear the sand pack of fines and to re-orient the sand grains to provide an effective sand filter for the piezometer.

2.1.4 HydroPunch™ Sampling

Groundwater sampling was accomplished by utilizing the HydroPunch™ tool manufactured by QED, Inc. The HydroPunch™ is a metal cylinder that attaches to the drive rod of the drill rig.

Table 2-1
Piezometer Construction Summary
Former Macon Naval Ordnance Plant

Number	State Plane Coordinates Location ID East	North	Ground Elevation (ft-amsl)	Bottom Of Well Elevation (ft-amsl)	Boring Depth (feet below surface)	Measuring Point Elevation (ft-amsl)	Bottom Of Casing (feet below surface)	Casing Stick-up (feet above ground surface)	Top of Screen Elevation (ft-amsl)	Bottom of Screen Elevation (ft-amsl)
PZ-1	658986.269	1010971.392	322.62	290.62	32.0	325.17	21.0	2.55	301.62	291.62
PZ-2	661746.589	1011352.846	350.95	300.95	50.0	350.70	39.5	-0.25	311.45	301.45
PZ-3	660709.404	1009930.008	343.82	286.82	57.0	346.12	44.5	2.30	299.32	289.32
PZ-4	660710.800	1009238.556	332.96	282.96	50.0	335.11	39.5	2.15	293.46	283.46
PZ-5	659173.212	1008907.390	308.18	283.18	25.0	310.48	14.5	2.30	293.68	283.68
PZ-6	661729.584	1008681.525	304.86	274.86	30.0	307.21	19.5	2.35	285.36	275.36

Notes:
Casings and screens are 10' by 2" PVC.
PZ-2 is a flush-mount well.
ft-AMSL = feet above mean sea level

It is equipped with a retractable shield which exposes a screen allowing groundwater to flow into a sample chamber. The passive fill system employed allows a groundwater sample to be collected by using the aquifer's hydrostatic pressure. At each piezometer location, one HydroPunch™ groundwater sample was extracted by advancing the HydroPunch™ approximately 5-feet ahead of the terminated boring and then pulling back the retractable shield to expose the screen and allow groundwater to enter the sample chamber. The HydroPunch™ was left in the ground for at least 40 minutes to allow the sample chamber to fill with groundwater. The groundwater sample was then retrieved and tested in the field for pH, temperature, specific conductivity, and dissolved oxygen.

2.1.5 Hydraulic Slug Tests

Following piezometer development, the hydraulic conductivity of the water-bearing zone was evaluated using the slug test method. The static groundwater elevation was measured and recorded. Afterwards, a slug was introduced into the piezometer to produce a rise in water level. The groundwater was then allowed to stabilize, and the test was begun at the moment the slug was removed from the water. Subsequent water displacement versus time was measured using a Hermit datalogger and pressure transducer. The resulting data were evaluated using the Bouwer & Rice method for unconfined aquifers with completely or partially penetrating wells (Bouwer, Rice, 1976). Results and calculations are included in Appendix A.

2.1.6 Survey

A topographical survey of the MNOP site boundaries, monuments, and recent boring and piezometer installations was performed by Entech, Inc. of Marietta, Georgia. The survey was performed using aerial photography, walking and mapping the site, and review of records and maps owned by the Macon-Bibb County Allied Industrial Park. Topography maps presented in this report along with boring and piezometer locations and their elevations above mean sea level (amsl) were generated from this survey.

2.1.7 Decontamination

Cleaning and decontamination of the field equipment was performed in a consistent, uniform manner. The drill rig was decontaminated using a pressure steam cleaner upon initial mobilization to the site and upon demobilization from the site. All downhole drill tools, split-spoon samplers, HydroPunch™, and downhole measuring equipment were decontaminated upon mobilization to the site and between each borehole or piezometer thereafter. Decontamination procedures were performed at a single designated area, which was central to the performed

borings on site. A special decontamination area with containment was also set up at this location, but was not needed since no contamination was encountered.

Split-spoon samplers were decontaminated using clean potable water, alconox soap, and a scrub brush. The samples were rinsed with potable water, rinsed again with isopropyl alcohol, and rinsed a third time with distilled water. HydroPunch™ equipment was decontaminated using a pressure steam cleaner supplied by the drilling crew.

All soil cuttings were collected in 55-gallon drums for possible disposal as contaminated waste. Because contamination was not indicated using the OVA at any of the boring locations, soil cuttings were later spread on the ground surface at each boring location as discussed in the Geotechnical Data Acquisition/Quality Assurance Plan (GDAP/QAP) dated June 27, 1994. All borings were then grouted to the surface using a mixture of one 94-pound bag of Portland Type II cement to seven gallons of potable water and five pounds of bentonite powder.

2.2 PHYSICAL SETTING

2.2.1 Geographic Setting

2.2.1.1 Physiographic Setting

The MNOP property is located in Bibb County, within the Fall Line Sand Hills of the Coastal Plain physiographic province in central Georgia. The site lies approximately 10 miles south of the Piedmont Physiographic Province, which is underlain by crystalline bedrock of Paleozoic and older age. The Coastal Plain province is composed of Cretaceous and younger unconsolidated sediments, limestone, and sandstone rock that overlie the older bedrock of the Piedmont province. These deposits commonly dip and increase in thickness toward the southeast. The Fall Line Sand Hills region, which extends in a northeastward-trending belt across Georgia, exhibits a distinctive topography of light colored sandy hills that rise to nearly 800 feet amsl in Taylor County to the southwest. Topographic relief within the region can reach 300 feet. The topography at the site slopes from north to south from approximately 370 feet to less than 300 amsl (USGS, 1985). The sandy mantle of the Fall Line Sand Hills region is loose, incoherent, and very hilly. Streams are more widely spaced relative to the Piedmont province, and cut deep precipitous gullies which actively erode sand from the upland areas. Hence sand is removed from the gully heads by rain-wash and deposited in the gully bottoms as subaerial deltas (LeGrand, 1962).

2.2.1.2 Surface Water Features

The Fall Line Sand Hills region lies within the drainage basins of the Ocmulgee and Flint Rivers. These two rivers follow more or less parallel courses to the south. The MNOP site lies within the drainage basin of the Ocmulgee River. The Ocmulgee is located east of the MNOP, flowing through eastern Bibb County. The floodplain of the Ocmulgee is generally about 2 miles wide. All streams flowing into the Ocmulgee have a predominantly southeast course. Almost all small tributaries flow southward to join the larger creeks at an acute angle (LeGrand, 1962).

Within the vicinity of the MNOP, the dominant drainage feature is Rocky Creek, which defines the southern boundary of the MNOP property. This stream exhibits a well developed floodplain and enters the Tobesofkee Creek about 1 mile southeast of the site. Tobesofkee Creek in turn forms a confluence with the Ocmulgee River 5 miles farther to the southeast.

2.2.1.3 Climate

The climate within the study area is humid and temperate. Precipitation occurs predominantly as rainfall which is evenly distributed throughout the year. The average annual precipitation within the Macon, Georgia area is 44.60 inches. Generally, the months with the lowest rainfall are September, October, and November (LeGrand, 1962). The annual mean temperature is approximately 62 degrees Fahrenheit (°F).

2.2.1.4 Water Use and Quality

According to LeGrand (1962), all municipalities within the vicinity of the study area use water from wells except for the city of Macon, which treats water from the Ocmulgee River. Industrial groundwater use is more frequent south of Macon. Local irrigation using well-water is practiced, but the overall use is small.

Three water-supply wells currently exist on the MNOP property. A 287 foot water well was installed during Department of Defense ownership and provided nonpotable water to plating operations in Buildings 5-A and 5-B. According to site personnel the pumping apparatus is still in place, but is nonfunctional. It is unclear when the well was last used. Another nonpotable water-supply well is located on the southern portion of the property, between the southern perimeter road and the Central of Georgia railroad spur. This 280 foot well is owned by Armstrong Cork and is currently active. During this investigation, a third water supply well was drilled at the MNOP site. The well is owned by Georgia Hydrate Corporation which recently acquired property from the Macon-Bibb County Industrial Authority. The well is located in the

southeastern corner of the MNOP property, near the railroad spur used during past site operations. The well was drilled to 290 feet by Green's Water Well Company of Gray, Georgia. Site personnel questioned, were unclear as to whether the water will be used for industrial purposes only.

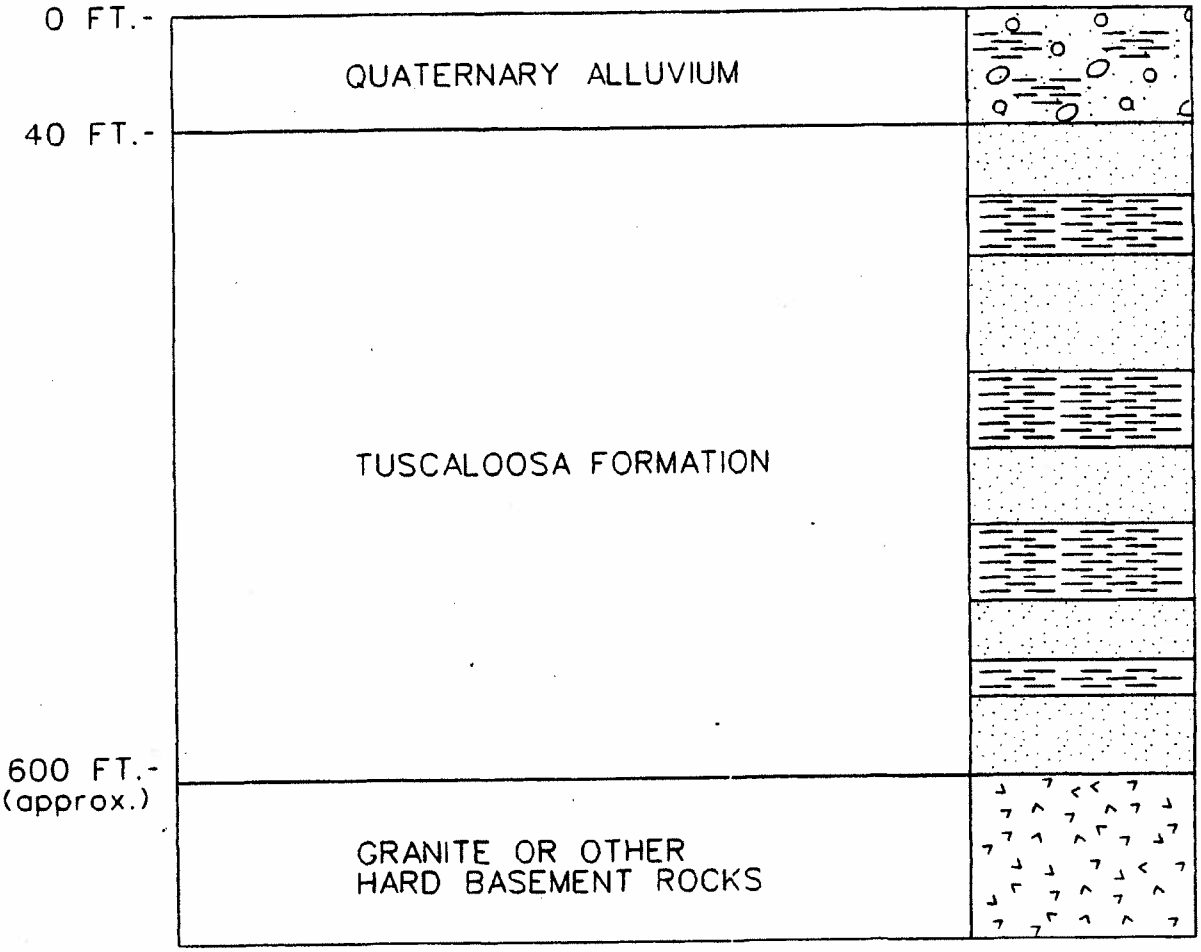
Due to the relatively insoluble nature of the Cretaceous sediments, the groundwater in the area is extremely low in dissolved solids content, and it is soft, exceeding 30 ppm total hardness in only a few places. Regionally, groundwater occurring in sandy formations similar to those at the MNOP have a pH of 7.0 or less, making them slightly acidic. No brackish or saline waters have been found in the surrounding area (LeGrand, 1962).

2.2.2 Regional Geology

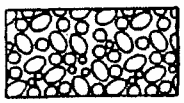
Prior to early Cretaceous time, southern Georgia consisted of igneous and metamorphic rocks, similar to those of the Piedmont province to the north. In the early Cretaceous, the region entered a period of subsidence, allowing the sea to encroach upon the pre-Cretaceous crystalline rocks. A series of advances and retreats of the sea level followed. Along the Fall Line Sand Hills, materials eroded from land areas to the north are deposited over the pre-existing igneous and metamorphic rocks. Much of the Cretaceous sediments were deposited on lowland margins before reaching the sea. Other deposits were eroded and redeposited in the sea. Whether deposition occurred along coastal margins or in the sea, the sediments are preserved in nearly flat, gently coastward-dipping layers (LeGrand, 1962).

In the vicinity of the MNOP, the rock units, in ascending order, are: Pre-Cretaceous igneous and metamorphic rocks, Cretaceous sediments, and Quaternary alluviums. The igneous and metamorphic rocks of Paleozoic and older age are comprised of granites, biotite-granite gneisses, and minor occurrences of altered volcanics and slate (LeGrand, 1962). Figure 2-2 presents a stratigraphic column of the regional geology.

The Cretaceous-aged Tuscaloosa formation is the surficial geologic unit underlying the MNOP. The formation consists of light-colored sand, sandy clay, and discontinuous clay lenses. According to LeGrand (1962), the formation does not indicate regular or cyclic deposition and is poorly developed and discontinuous, with no individual beds being traced far. In keeping with the regional trend, the Tuscaloosa thickens to the south with a regional dip of 30 feet per mile to the south. About 9 miles south of the MNOP it is overlain by younger sediments. Where this occurs, the Tuscaloosa formation is as much as 600 feet thick. The thickness of the formation under the MNOP has not been measured, but it is probably less than 600 feet (LeGrand, 1962).



EXPLANATION



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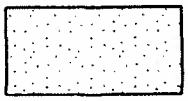
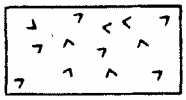


SAND

CLAY



GRANITE

NOT TO SCALE

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-2
STRATIGRAPHIC COLUMN
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA
RUST PROJECT 32455.000
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Quaternary alluvium sediments are the surficial deposits in the floodplains of creeks and rivers in the area. The Quaternary alluvial sediments are interpreted to have been deposited in a meandering stream depositional environment. These deposits consist of two distinct types: a peat/clay back-swamp unit and a sand and gravel point-bar unit. Under a meandering stream scenario, these two units may be repeated several times within a stratigraphic interval. As point bars migrate laterally, perpendicular to the direction of stream flow, they deposit a fining upward sequence of cross bedded gravel, sand, and silt. Eventually these sediments are situated behind the stream levee and are overlain by swamp and marsh deposits of organic-rich peat and clay. As the stream meanders back across this sequence, a sharp basal contact of gravel and sand is deposited over the peat/clay unit, and the sequence is repeated. The thickness of the Quaternary deposits south of the MNOP have not been measured, but may extend to 60 feet below land surface (bls).

2.2.3 Regional Hydrogeology

Few wells have been drilled into the igneous and metamorphic units which occur at depth in the region. Thus, few data are available concerning their water-bearing properties. Based on rocks of similar composition found in other parts of Georgia, these units yield only small supplies of water with average expected yields rarely exceeding 20 gallons per minute. No information concerning these rock units is available for the MNOP property.

Groundwater use within the area of the MNOP is derived from the Cretaceous aged Tuscaloosa formation which directly overlies the Paleozoic and older crystalline rocks discussed above. Sand beds within the Tuscaloosa are the general source of groundwater to area wells. Due to the sandy soils occurring at the outcrop of the Tuscaloosa, a relatively high percentage of precipitation percolates through the subsurface rather than flows overland. Thus, recharge areas for groundwater generally occur in the uplands with shallow groundwater discharging into streams and associated wetlands. In these areas, the aquifer may experience partially to fully confining conditions because of the characteristics of the overlying Quaternary alluvium.

South of MNOP and down dip of its outcrop area, the Tuscaloosa is overlain by impermeable clays which create artesian conditions. The outcrop area extends approximately nine miles south of the MNOP property. Throughout the Tuscaloosa, sand beds are lenticular and cannot be traced for any distance. However, several sand beds are generally encountered in individual wells drilled to at least 250 feet (LeGrand, 1962). Therefore, the discontinuity of the sand beds does not impair the development of an adequate supply of groundwater. There are no regional confining units within the Tuscaloosa formation. However, the occurrence of discontinuous clay-rich layers may create confined conditions in localized areas. These layers may impede, but would not prohibit, groundwater flow between sedimentary layers.

The Quaternary deposits described in Section 2.2.2 are composed of alluvial materials deposited along stream and river channels. Such deposits are capable of supplying water only where they are of sufficient thickness. The Ocmulgee River, east of the MNOP, may be able to support water to industrial wells in certain areas. However, no reference was found to such water use in the Quaternary deposits. In upland areas, alluvial deposits are thin and water leakage to lower slopes is significant, making these areas of limited use for water supply.

2.2.4 Site Geology

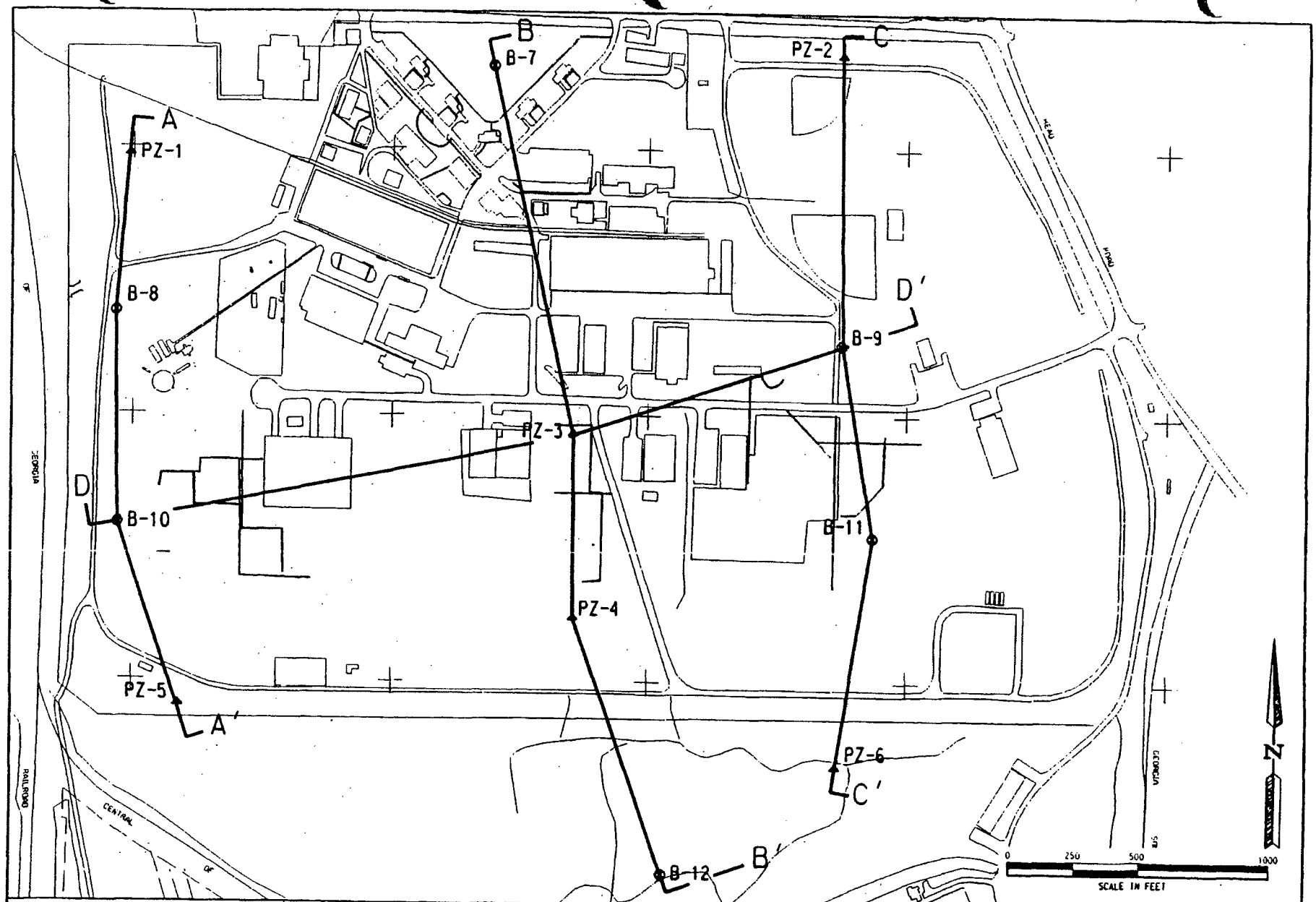
The geology of the MNOP site generally consists of unconsolidated sediments of interbedded clayey silts and silty clays which grade with depth into silty sands (Figures 2-3 through 2-7). Sediments below the water table are dominated by silty sands, while those above show an increase in fines, such as silts and clays, with decreasing depth. Thin layers of sandy gravel appear in discontinuous lenses throughout much of the site area. The presence of these gravels, along with a repeated sequence of general fining of materials upward, suggests a point-bar, depositional environment laid down through a series of meandering streams. Zones of sandy clays and clay lenses also exist across the site, concentrated mostly above the surficial aquifer, and these lenses appear to be discontinuous. In the northwest portion of the MNOP, west and northwest of the former waste water treatment plant, there is a proportionally greater degree of fines that continue with depth below the upper gravel layer (Figure 2-4). This is a low lying area where groundwater is within 5 feet of the surface.

Sediments throughout the site vary in color between shades of white, brown, red, and orange. White to tan clayey sands and clayey silts appear with greater frequency along the southern portion of the MNOP site, apparently due to a predominance of feldspar and muscovite. Sands, mixed with silts and clays, range from fine to coarse grain and occasionally contain gravel. The major constituents of the sandy sediments throughout the site are generally quartz with lesser amounts of feldspars and muscovite. Where gravel is present, it consists of quartz, quartzite, feldspar, and, in places, chert.

2.2.5 Site Hydrogeology

2.2.5.1 Surface Hydrology

The topography at the MNOP is generally flat with a few gentle slopes. The entire site slopes gently southward (Figure 2-8). A small stream enters the MNOP property at the northeast corner and runs parallel to Mead Road before it exits the site south of Allied Industrial Blvd. A few drainage ways exist in the former bunker area where storm water drain outlets empty onto the field. Ponded water exists north of the Central of Georgia Railroad spur near boring B-12.



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DRAWN BY	M.PEARCE	11/94
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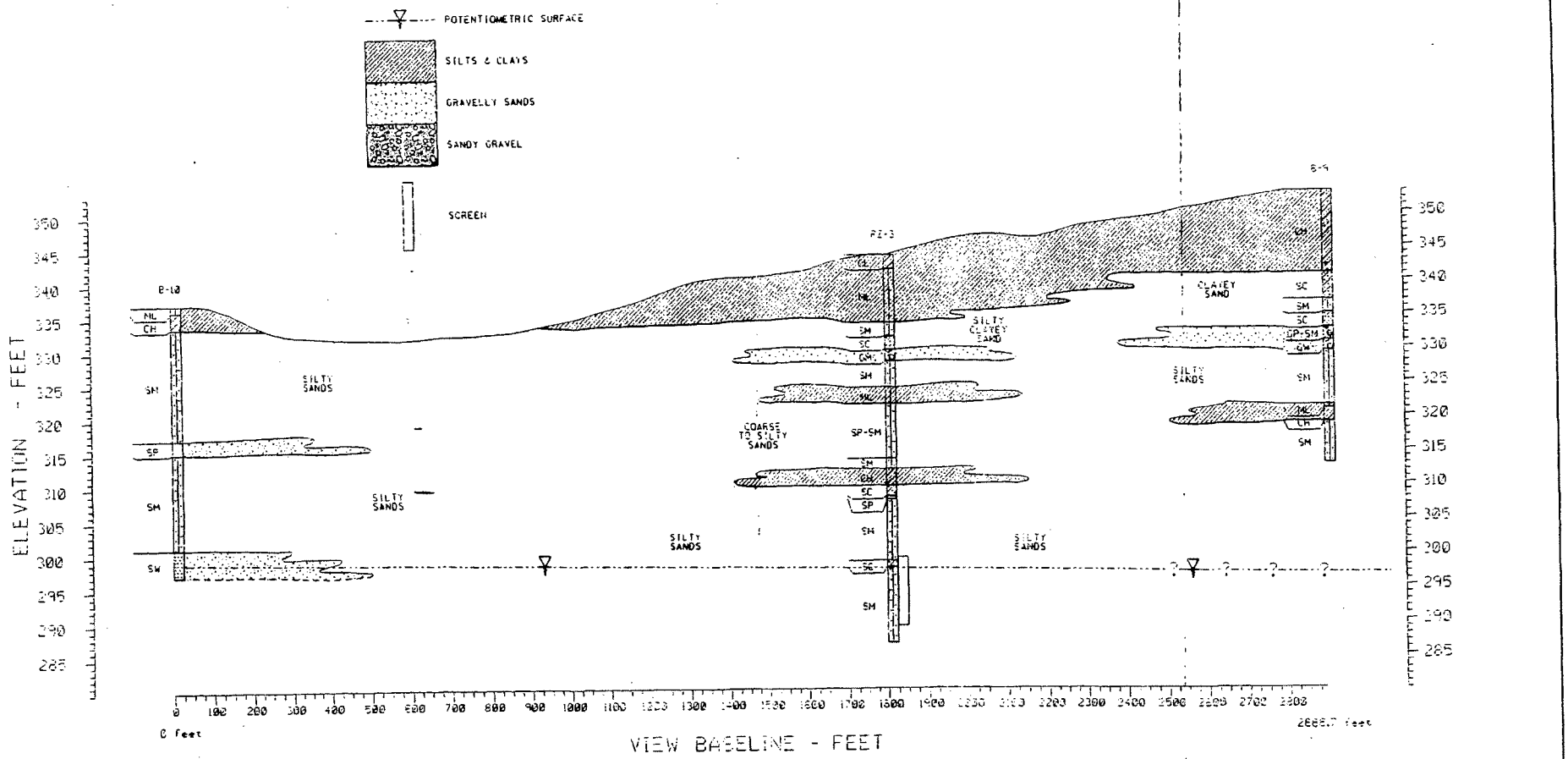
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-3
CROSS SECTION LOCATION MAP
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



Horizontal Scale: 1 inch = 250 ft
Vertical Scale: 1 inch = 15 ft
Vertical Exageration = 16.66667 Ft/Ft

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DESIGNED BY	D. HELLER	12/94
DRAWN BY	MJS	12/94
CHECKED BY		
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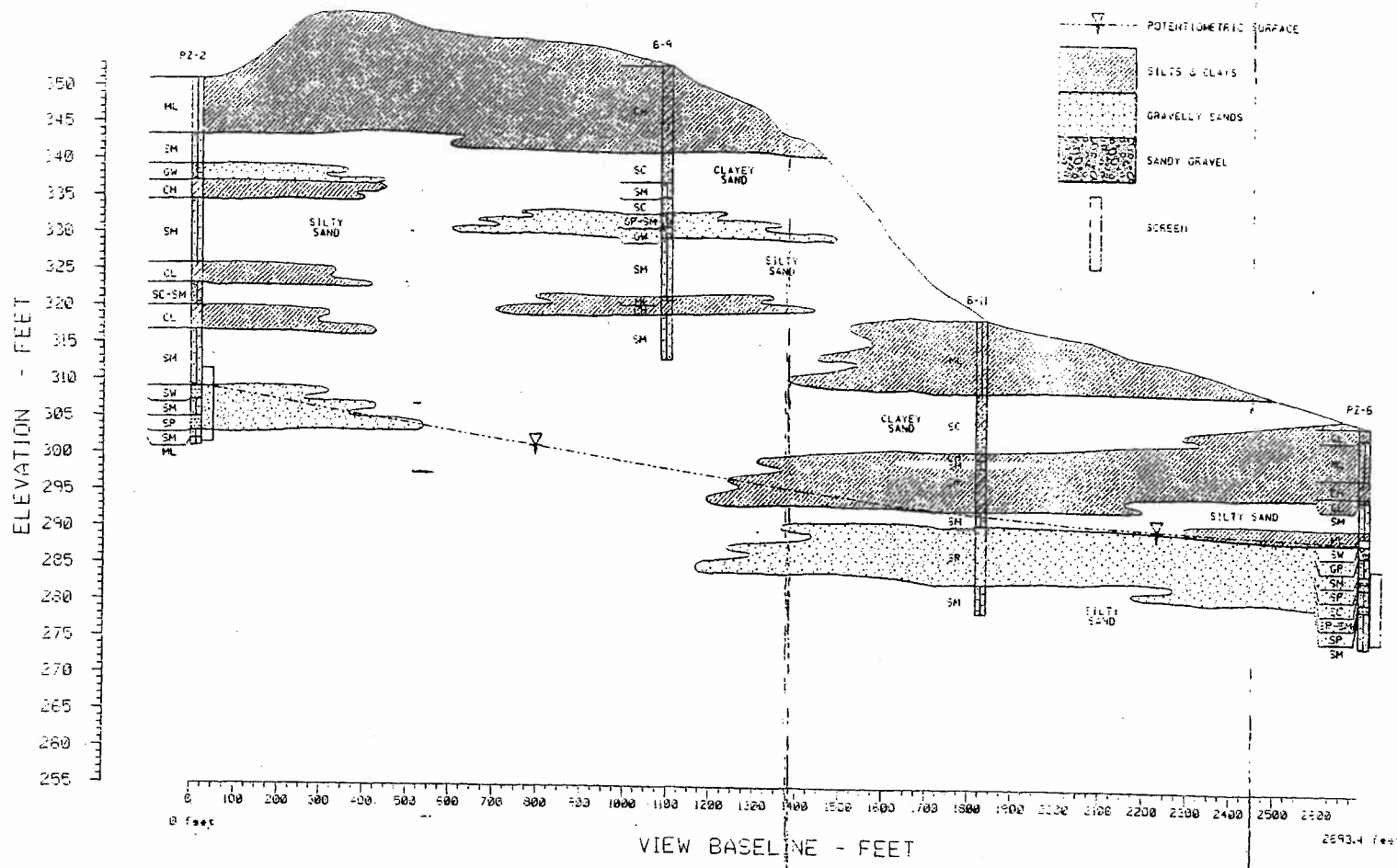
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-7
CROSS SECTION D-D'
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



Horizontal Scale: 1 inch = 250 ft
Vertical Scale: 1 inch = 15 ft
Vertical Exageration = 16.66667 ft/ft

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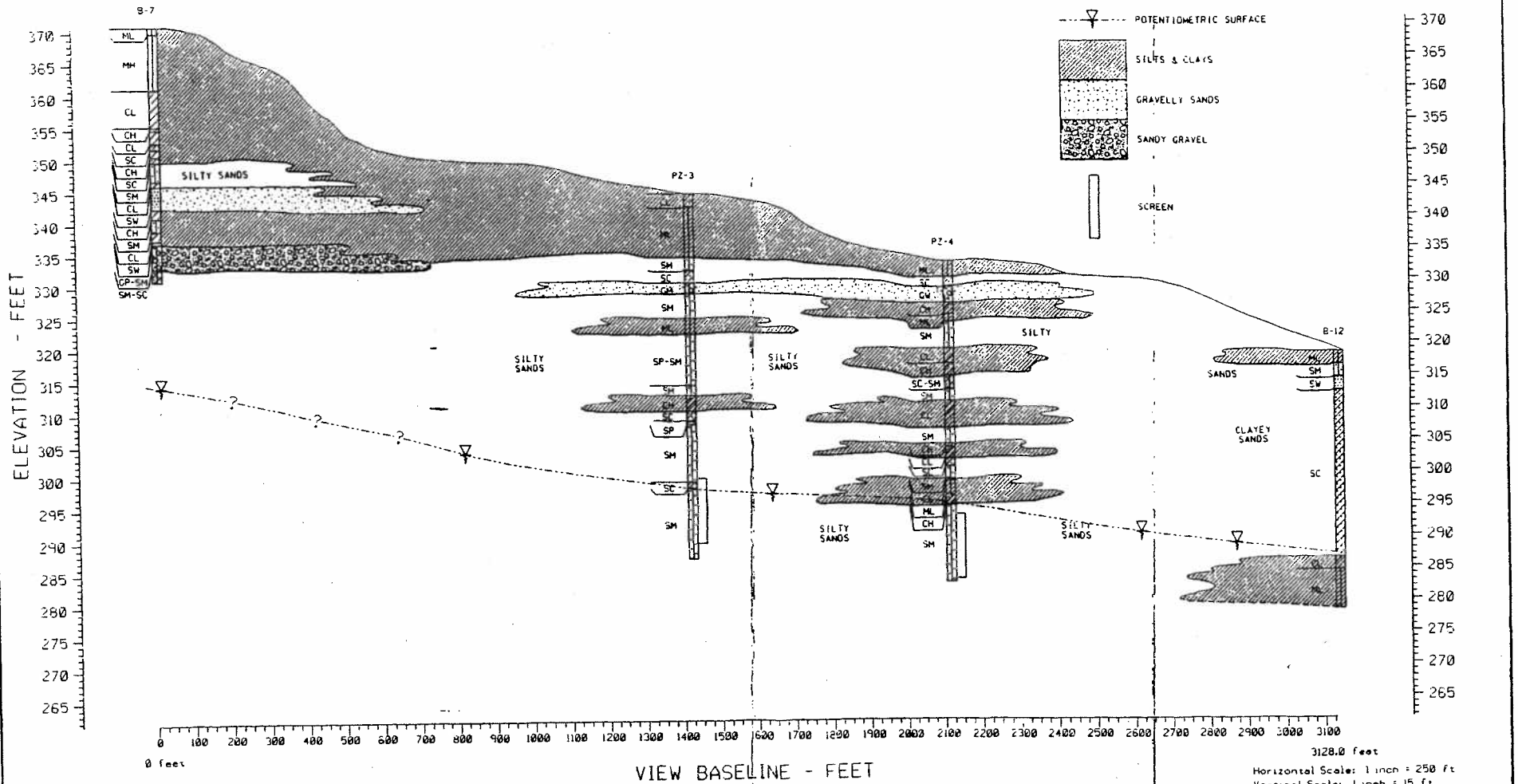
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-6
CROSS SECTION C-C'
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



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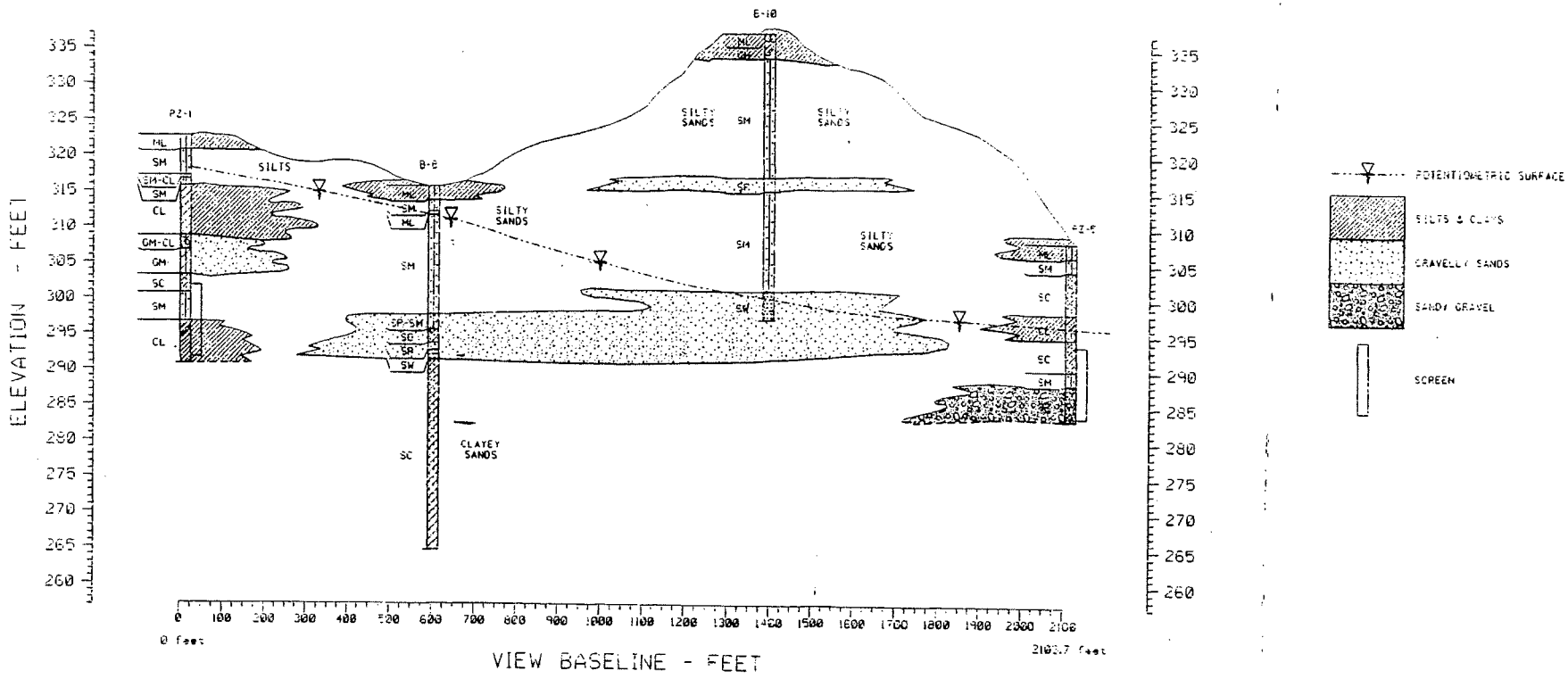
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-5
CROSS SECTION B-B'
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



Horizontal Scale: 1 inch = 250 ft
Vertical Scale: 1 inch = 15 ft
Vertical Exageration = 16.66667 ft/ft

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RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-4
CROSS SECTION B-A'
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-8
SITE TOPOGRAPHY MAP
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA
RUST PROJECT 32455.000
32455018 12/94

A topographic low occurs in the northwest section of the site where surface drainage appears to run off during storm events into a small creek running along the west property boundary. This creek eventually crosses over onto the property south of the former Central of Georgia railroad spur in the southwest portion of the property and empties into meandering streams in a wooded area east of the MNOP landfill. The former landfill site is situated in a low lying portion of the flood plain of Rocky Creek and is surrounded by standing and flowing waters.

2.2.5.2 Groundwater Hydrology

The groundwater flow direction within the site area is generally in the south-southeast direction, based on piezometer water levels taken on October 18, 1994 and soil borings data collected two weeks previous. The potentiometric surface map (Figure 2-9) shows a general flow direction to the southeast where groundwater flow appears to diverge away from the City of Macon Water Works, possibly resulting from a mounding effect due to the water works development. Depth to groundwater varied from 5 feet below land surface (bls) at piezometer PZ-1 to 46.8 feet bls at piezometer PZ-3 (Table 2-2). Static water levels correlated to elevations above mean sea level (amsl) ranged from 317.6 feet amsl at piezometer PZ-1 to 284.5 feet amsl at boring B-12, resulting in a general difference of 33 feet.

The hydraulic conductivity for the surficial aquifer was estimated by conducting hydraulic slug tests, described in Section 2.1.5. This parameter is a measure of a fluid's ability to move through a porous media under a unit gradient and is an important variable in evaluating groundwater flow velocities. Results are summarized in Table 2-3. Calculations indicate the average hydraulic conductivity for the six piezometers tested to be 2.1×10^{-3} feet per minute (ft/min).

Horizontal groundwater gradients were estimated based on the flow directions shown in Figure 2-9. An average gradient was calculated from the three flow lines shown. The horizontal average linear flow velocities were calculated using the Darcy equation (Fetter, 1988). Calculations for the flow velocities are shown in Appendix A. The results indicate groundwater flow across the site is approximately 44 feet per year using the average hydraulic conductivity value reported above. Groundwater flow was also calculated using the highest hydraulic conductivity value of 6.3×10^{-3} ft/min from piezometer PZ-5. In this case, PZ-5 was screened in gravel, which attributed to a higher hydraulic conductivity. The calculated linear flow velocity for piezometer PZ-5 was 132 feet per year.

RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 2-9
POTENTIOMETRIC SURFACE MAP - 10/18/94
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA
RUST PROJECT 32455.000
32455002 11/94

Table 2-2
Static Water Level Readings
Former Macon Naval Ordnance Plant

Well	Water Level Elevation		Water Level Elevation	
	(ft-bls)	(ft-amsl)	(ft-bls)	(ft-amsl)
	10/18/94		11/8/94	
PZ-1	4.98	317.64	3.88	318.74
PZ-2	42.81	308.14	42.25	308.70
PZ-3	46.78	297.04	46.20	297.62
PZ-4	38.76	294.20	38.10	294.86
PZ-5	13.24	294.94	12.16	296.02
PZ-6	15.23	289.63	14.27	290.59

Note:
ft-bls = feet below land surface
ft-amsl = feet above mean sea level

Table 2-3
Hydraulic Conductivity Summary
Former Macon Naval Ordnance Plant

Well No.	Type Test	Hydraulic Conductivity		
		(cm/sec)	(ft/min)	(ft/day)
PZ-1	Rising Head	5.6E-04	1.1E-03	1.59
PZ-2	Rising Head	2.4E-04	4.7E-04	0.67
PZ-3	Rising Head	9.0E-04	1.8E-03	2.54
PZ-4	Rising Head	1.3E-03	2.6E-03	3.77
PZ-5	Rising Head	3.2E-03	6.3E-03	9.03
PZ-6	Rising Head	2.4E-04	4.7E-04	0.68

Note:

Hydraulic conductivities are based on calculations included in Appendix A.

2.3 ANALYTICAL DATA SUMMARY

2.3.1 Soil Samples

Two soil samples were collected from selected levels at each soil boring and tested for grain size distribution, Atterburg limits, and moisture content by Analytical Services Inc. Results from grain size analysis indicated the MNOP soils generally consist of fine to medium and fine to coarse sand mixed with silts and clays. Lab results are listed in Appendix A, and are also included in the soil boring logs in Appendix A.

2.3.2 HydroPunch™ Samples

HydroPunch™ sampling results from the six piezometer borings are shown in Appendix A. Results show that temperatures ranged from 17.5 to 24 degrees centigrade (°C), pH ranged from 4.92 to 6.2 with an average pH of 5.7, specific conductivity ranged from 80 to 190 umhos/cm and averaged 112.5 umhos/cm, and dissolved oxygen ranged from 1.7 to 4.33 mg/l averaging 3.12 mg/l. No specific conclusions can be drawn from the HydroPunch™ data concerning possible contamination zones.

2.4 HYDROGEOLOGIC MODEL

Based on the limited scope of the GDAP/QAP phase of this project, certain assumptions were made in developing a preliminary conceptual hydrogeologic model. This project was confined to drilling depths of approximately 40 feet with the maximum depth drilled being 55 feet. Therefore, this study examined only the uppermost surficial aquifer of the MNOP. It is this surficial aquifer within the Tuscaloosa Formation on which the hydrogeologic model is based.

The surficial aquifer was found to be unconfined. The depth from ground surface to the surficial aquifer ranged from 4 to 48 feet across the MNOP area. The total thickness of the aquifer is unknown, but it is assumed that the Tuscaloosa Formation is less than 600 feet thick at this location (Section 2.2.2). The internal structure of the aquifer consists, in general, of fine to coarse grained sands. The overlying sediments consisted of finer, somewhat less permeable material composed of discontinuous interbedded lenses of silty clays, clayey silts and silty sands (Figures 2-3 through 2-7). Discontinuous clay-rich layers may occur within the surficial aquifer which impede groundwater flow for a limited distance.

Because the overlying sediments are relatively permeable, recharge of the aquifer occurs across the upland areas of the MNOP. The vertical hydraulic gradient in this area would be downward. Recharge occurs chiefly through rainwater, which percolates down through the overlying finer

sediments of the MNOP into the more porous saturated sands of the upper aquifer. In areas where clay lenses appear to overlap each other, water percolates down in a step fashion, inhibited by the relatively impermeable layers, until it reaches the surficial aquifer below. In general, the overlying sediments can be conceptualized as acting as a strainer, slowly allowing rainwater to filter down and recharge the more transmissive layer of the surficial aquifer. Because of the occurrence of relatively impermeable clay layers, a portion of the rainwater would be expected to be captured as runoff along intermittent stream beds and into the local drainage systems.

Discharge from the surficial aquifer occurs immediately south of the property, into the marshes and wetlands of the Rocky Creek floodplain and ultimately into Rocky Creek itself. In this area, the vertical hydraulic gradient would be upward. Groundwater movement across the MNOP is to the southeast toward Rocky Creek, a tributary of the Ocmulgee River located 4 miles southeast of the site. Locally, groundwater from the surficial aquifer is discharged into Rocky Creek where the potentiometric surface intersects the topographic surface (Figure 2-9). A portion of the recharge from upland areas would contribute to the regional recharge of the Tuscaloosa formation down dip and to the south.

2.5 RECOMMENDATIONS

Based on the results of the hydrogeologic investigation performed, a preliminary conceptual hydrogeologic model for the MNOP has been prepared. In order to better define groundwater conditions at the site and resulting impacts to possible environmental releases, the collection of additional groundwater data is recommended.

The potentiometric map presented in Figure 2-9 represents a general understanding of groundwater flow across the site in the surficial aquifer. Variations from this interpretation will occur on a localized basis. In areas where contamination is suspected, a refined delineation of groundwater flow will be necessary. In addition, a more refined potentiometric map will be necessary to more fully determine the potential for environmental impacts from off-site sources.

Nested well locations are recommended to define areas of recharge and discharge across the site. This information will be necessary to delineate flow paths for contaminants identified during the next phase of the site investigation. Nested well locations will aid in defining the vertical and horizontal extent of any contaminants present. The recommended additional hydrogeologic information can be obtained as part of future work conducted at the site to characterize possible environmental impacts caused by DOD activities. Therefore, collection of this additional information has been incorporated into the recommendations set forth in Chapter 6.0 of this report.

3.0 ENVIRONMENTAL CONDITIONS

3.1 PREVIOUS ENVIRONMENTAL STUDIES

The USACOE Savannah District completed a Draft Project Report (DPR) for the MNOP in July 1989 (USACOE Savannah,1989). It consisted of a records search and a June 30th site inspection to ".... assess the presence of unsafe debris, unexploded ordnance, and hazardous and toxic (H/T) materials on formerly used DOD lands...." This assessment provided much of the historic information cited by subsequent studies. It describes the sewage treatment facility as being still present and states the plant was used to ".... treat domestic waste as well as waste water from the metal plating plant on base." The site survey identified the hazard to be potential H/T contamination and unexploded ordnance. The DPR recommended testing for unexploded ordnance in applicable areas and conducting confirmation studies to determine potential environmental hazards.

Review of the Resource Conservation and Recovery Act (RCRA) files at the Georgia EPD offices in Atlanta, Georgia identified an environmental assessment report in the files of PB&S Chemical Corporation (PB&S), a current landowner at the Allied Industrial Park. The environmental assessment was conducted by Beaver Engineering, Inc. for PB&S. The report was issued October 4, 1989. The assessment consisted of soil sampling in the area of the current property owned by PB&S. The report indicated the presence of elevated levels of heavy metals and trace amounts of volatile organics in the soil samples analyzed.

A Site Survey Summary Sheet dated February 28, 1992, for the MNOP was found in records provided by USACOE. It indicates the site was inspected for the presence of unexploded ordnance on July 24, 1989, and that the inspection found no evidence to suspect the presence of unexploded ordnance. A Project Summary Sheet of the same date references a Chemical Contamination Study, (the findings of which appear to be those of the September 1990 study cited in the next paragraph), and proposes a Remedial Investigation/Feasibility Study (RI/FS) be conducted.

Two other previous environmental investigations involving laboratory analyses of site media are known to have been conducted at the MNOP site. The first was the *Engineering Report/Confirmation Study of the Former Macon Naval Ordnance Plant* conducted by Environmental Science and Engineering, Inc. (ESE) in September 1990, for the USACOE Mobile District, Mobile, Alabama. This work was conducted as part of the Defense Environmental Restoration Program (DERP). The study focused almost exclusively on the MNOP landfill, but did involve a limited study of the Oil Recovery Area near Structure 117 (ESE September 1990). The second environmental investigation was conducted by Westinghouse

Environmental and Geotechnical Services (WEGS) in May 1991 for the Macon-Bibb County Industrial Authority. This study assessed a limited area of the MNOP which was south of the current Allied Industrial Boulevard and east of the roadway connecting Allied Industrial Boulevard with the south perimeter road (WEGS, May 1991).

Both the ESE report and the WEGS report indicated the existence of contamination in the areas investigated. The ESE study cited the existence of heavy metals, explosives constituents, and unidentified petroleum hydrocarbons. The Hazardous Ranking System Evaluation, which was completed for the ESE investigation, identified the detected hazardous substances as trichloroethene (TCE); 1,3-dinitrobenzene; 2,4-dinitrotoluene; and unidentified petroleum hydrocarbons, (ESE, 1990; Appendix B). The ESE report cited the lack of a reliable background sample as reason for not speculating on the significance of heavy metal concentrations detected during the investigation. They concluded that the levels of contamination might require regulatory review and recommended that the findings be ".... referred to the appropriate office or agency for determination of a future course of action." (ESE 1990) The WEGS report cited the detection of TCE as well as heavy metals, but also cited the lack of background data for not establishing any clear remedial action requirements. No soil samples were collected for the WEGS study, and no explosives compounds were cited in their findings or conclusions.

The Hazardous Waste Management Branch of the Environmental Protection Division of the Georgia Department of Natural Resources (Georgia EPD) completed a U.S. Environmental Protection Agency (EPA) authorized Preliminary Assessment (PA) of the MNOP in July 1992. This assessment reviewed the available environmental studies and records, conducted a comprehensive target survey, a site reconnaissance and interviews. It concluded the site was a candidate for further investigation (Georgia EPD, July 1992).

3.2 REGULATORY ACTIONS

3.2.1 Facility Identification

The following information was compiled from data reviewed at the Region IV offices of the U.S. EPA in Atlanta, Georgia.

There have been three different EPA ID numbers discussed in association with the subject study, but only two have actually been assigned to property which was part of the MNOP. The first two numbers separated the property north of the Central of Georgia Railroad (GAD039136080) from that south of it (GAD003302676); they basically separated the MNOP landfill from the MNOP production facility property. The first number, however, included the property east of

MNOP, located at 4652 Mead Road, with that north of the railroad (the MNOP production area), and assigned the entire property the 4652 Mead Road street address. At the time of the 1979 discovery of the 4652 Mead Road site, Allied Chemical owned the property at that address as well as the MNOP property. The MNOP landfill was listed as having the 600 Guy Paine Road address. A letter dated 1-06-94, to Mr. William P. Thompson of the MBCIA, from Mr. Joseph R. Franzmathes, Director of the Waste Management Division of the EPA Region IV, describes the difference in the two area designations (See Appendix B).

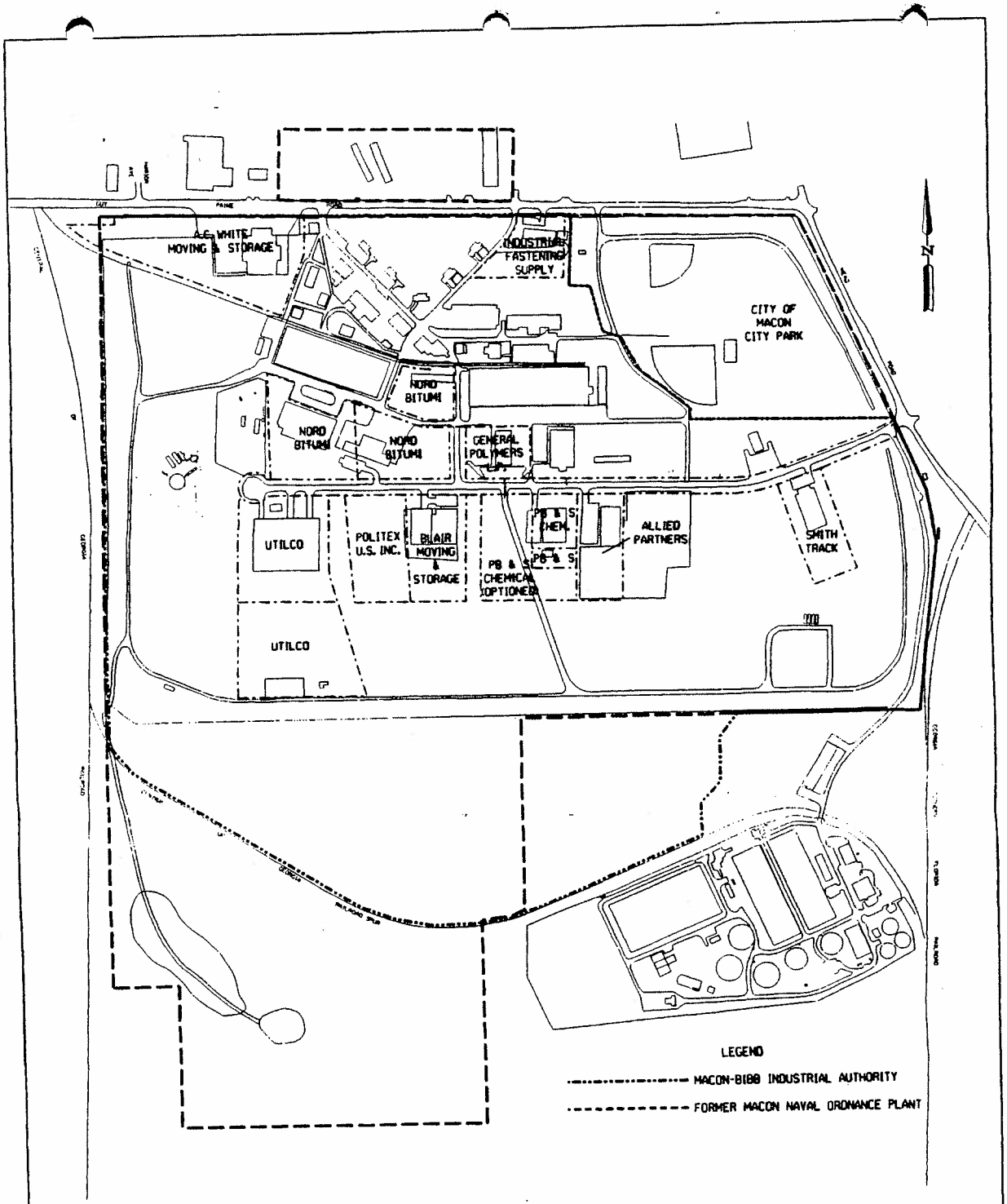
The third EPA ID number was derived recently, as the landfill was assigned a new number to separate it from the MNOP production facility, which is now known as the Allied Industrial Park. An internal EPA Region IV memorandum from the Georgia Project Officer to the Planning & Information Management Unit describes the landfill as a new site discovered on January 21, 1994, upon discovery that the Allied/Former Macon Naval Ordnance Plant (GAD 003302676) was actually two sites. The landfill was assigned the number GAD0000102178 in 1994. The property east of the MNOP retained the number GAD039136080, which was formerly assigned to all the property north of the railroad, and the Allied Industrial Park assumed the number GAD003302676, which formerly identified the property south of the railroad. The resulting EPA ID numbers are as shown below:

- ALLIED INDUSTRIAL PARK - GAD003302676
- ALLIED CHEMICAL CORPORATION - GAD039136080
- MNOP LANDFILL - GAD0000102178

Appendix B contains a copy of EPA maps and referenced correspondence detailing the evolution in the MNOP facility ID numbers. Appendix B also contains a copy of the text from a 1990 site inspection of the Mead Road, Allied Chemical Site. The maps provided are color coded to show how the various ownership changes have affected the property boundaries over time. A site map, which depicts the current property boundary lines superimposed over a re-creation of the fullest extent of the MNOP, is presented as Figure 3-1.

3.2.2 Regulatory Actions

RUST E&I researched the public record for information on regulatory action pertaining to the MNOP. The public agencies contacted were as follows: U.S. EPA, Region IV, Resource, Conservation, and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) programs; the Georgia Department of Natural Resources, (DNR), Environmental Protection Division, (EPD); the Macon Fire Department; and the Macon Water Authority, Industrial Pretreatment Office. Specific offices within DNR that were contacted were the office of Hazardous Waste Management, Land Protection, Program



RUST PROJECT	32455.000
DESIGNED BY	D.HELLER
DRAWN BY	M.PEARCE
CHECKED BY	
FILE NAME	32455025

DATE: 1/95, 1/95

RUST ENVIRONMENT & INFRASTRUCTURE
ATLANTA, GEORGIA

FIGURE 3-1
MNOP PROPERTY BOUNDARY MAP
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

Coordination, (Emergency Response Team, Radioactive Materials), Water Protection (Municipal, Industrial, and Stormwater Permitting Program), and Air Protection. Rust E&I also solicited a sub-contract environmental database search of regulated facilities within the vicinity of the MNOP. The purpose of this research was to identify regulatory actions involving any Notices of Violation, (NOVs), applications for hazardous waste permits or other regulatory actions indicative of activity which could potentially impact the environmental regime of the MNOP.

Site-Specific Regulatory Actions

No NOVs for the MNOP property were found in the regulatory actions research. As stated earlier, the U.S. EPA and the Georgia EPD have conducted limited assessments of the property and concluded that there was a need for further investigation. The U.S. Department of Defense (DOD), in assessments conducted as part of the DERP activities, concurred that further investigation was warranted (See Section 3.1). The USEPA and Georgia EPD have consented to wait until the DOD study is complete before finalizing their assessments and incorporating the findings into their site inspections.

Other findings of the Regulatory Actions Research focused on records of the Georgia DNR and the Macon Fire Department. The findings are summarized below:

- Hazardous Waste Management - Information supporting that which was in the USEPA files was found. The only State regulatory action identified is the existence of the MNOP site on the new Hazardous Site Inventory or State Superfund list. The site is listed as a Category II site (requires further investigation), with known contaminants in groundwater listed as being lead, trichlorethylene, chromium, and barium. Information concerning some of the Allied Chemical Corporation activities at the MNOP property were found in a file labeled "General Chemicals - Macon Works". General Chemical is located at 4652 Mead Road, and as discussed earlier, Allied owned both this site and the MNOP site at one time. One internal memo, a trip report, dated January 3, 1977, discusses putting the MNOP property on a compliance schedule for handling regulated wastes. Of special concern was chrome sludge, which was collected in 55-gallon drums and stored on site temporarily. The sludge was then disposed of off-site at the Macon City Sanitary Landfill. The memo ends with two conclusions: "....1) the chrome sludge is classified as hazardous and is not managed in conformance with our rules and regulations, 2) the company landfill located on company property should be closed." This trip report also identifies "...a large landfill operated by the Armstrong Cork Company..." adjacent to the MNOP property. Another trip report, dated several months later, discusses

approving the use of the inactive waste water treatment plant at MNOP for further de-watering of metal plating sludge generated by Allied. No information was found indicating that such activities were approved or implemented.

- Files for PB&S Chemical, a current property owner at the MNOP site, were reviewed. The file contained an environmental assessment done by Beaver Engineering, Inc. in October 1989. The study included a history of property ownership, site geology, and the analytical results of soil samples from the property. The soil analysis showed elevated levels of some heavy metals and trace amounts of some volatile organic compounds. No evidence of non-compliance for PB&S Chemicals, or surrounding property owners researched as part of the environmental assessment, were identified.

- Land Protection - No regulatory actions were identified, and no additional information was collected.

- Program Coordination -

  Emergency Response Team: No record of emergency response actions was identified for the MNOP property.

  Radioactive Materials/Environmental Radiation Unit: No records were available on the MNOP.

- Water Protection Program - No records of regulatory action concerning the MNOP were found.

- Air Protection Program - No records of regulatory action concerning the MNOP were found.

- SARA Title III: Records of the Macon Fire Department, as provided by Ms. Betty Gronskei, Records Clerk, were reviewed by RUST E&I for SARA Title III information. Ms. Gronskei retrieved fire department files for facility names appearing on a list of on-site or off-site adjacent properties of the MNOP. No administrative actions or other significant findings relative to the environmental conditions at MNOP were identified.

Surrounding Properties Regulatory Actions

The regulatory files for properties in the vicinity of the MNOP were identified by filing written requests with pertinent regulatory offices of the USEPA and Georgia EPD. These requests listed

all identified adjacent properties and on-site leasees in an attempt to identify any sites which might impact the MNOP property. No obvious evidence of environmental impact to the MNOP from off-site sources was identified. The findings of this research are summarized in the following paragraphs.

Six RCRA files were reviewed at the Georgia EPD Hazardous Waste Management Office for properties immediately adjacent to the MNOP. These files were for General Chemicals-Macon Works; Riverwood International GA, Inc.; General Tire & Rubber; Keebler Co.; Schwartz & Sons, L.E.; and the Macon-Bibb County Rocky Creek Waste Water Treatment Plant. Of the files reviewed, only two had information on regulatory actions. Those were Riverwood International GA, Inc. (a.k.a. Macon Kraft, Inc.,; a.k.a. Georgia Kraft) and General Chemicals-Macon Works (a.k.a Allied Chemical Corporation).

The General Chemicals-Macon Works facility was originally known as Allied Chemical Corporation located at 4652 Mead Road. This property is on file with the USEPA as Allied Chemical Corporation, under facility ID# GAD39136080. The EPA completed an assessment of the property in 1990 and gave it a "No Further Remedial Action Planned" (NFRAP) status. It is clear from the Phase I Screening Site Inspection, dated August 23, 1990, (see Appendix B) that the EPA assessment concerned only the 22-acre site at 4652 Mead Road. Therefore, the NFRAP recommendation and eventual NFRAP status referred exclusively to the 4652 Mead Road site and not the MNOP property, even though the facility ID# GAD039136080 was assigned to all of Allied Chemical Corporation's property including the MNOP area.

The EPD Hazardous Waste Management files for this facility contained an Emergency Response Team Incident Report form concerning a spill of sulfuric acid which occurred on November 13, 1989 at the 4652 Mead Road site. An estimated 300 to 400 gallons of acid was spilled. No follow up information was found. This spill was not found in the Georgia EPD Hazardous Materials Emergency Response files. This file also contained information on the Allied Chemical Corporation, Automotive Products Division (a.k.a. MNOP). The information found was discussed earlier in this report with respect to site-specific regulatory actions, since this operation was located on the MNOP property. The Automotive Products Division on the MNOP property, though owned by the Allied Chemical Corporation, was never operationally connected with the facility at 4652 Mead Road, (the site of the referenced spill), which became known as General Chemical-Macon Works.

The Riverwood International GA, Inc. files contained copies of two separate Groundwater Quality Assessment Plan documents; one dated June 1992 (rev. May 1994) and the other dated January 25, 1994. Additional information concerning regulatory actions at this facility was found under the Georgia Water Protection Program files. The Macon Kraft, Inc. files contained

information on environmental problems identified at the time of purchase by Riverwood International, Inc. A Consent Order was issued by Georgia EPD in April 1992 for alleged violations of the Georgia Hazardous Management Act; specifically the Rules concerning hazardous materials handling. The facility had stored materials deemed hazardous by the State in waste piles and impoundments without obtaining proper permits and without following proper hazardous waste handling regulations. The material was deemed a D002 waste (pH greater than 12.5) based on information provided in the environmental assessment conducted prior to purchase. A settlement of $ 750,000 was reached with the State. The Consent Order required a Groundwater Quality Assessment be performed. This document was identified during the review of Georgia EPD Hazardous Waste Management Program files.

In addition to the alleged hazardous waste pile and impoundments, other areas of concern were documented in letters and internal memos between Macon Kraft and the Georgia EPD. These include discussions concerning proper closure of the facility's landfill, dry weather surface water discharges, clean up of oil-contaminated soils from the above ground and underground fuel storage tank area, and assessment of impacts due to a sulfuric acid spill.

Earlier letters and memos in the file indicate a history of problems associated with surface water discharges from this facility. In August 1981 a Consent Order was issued for illegal discharges and contaminated storm water runoff. Files indicate that in 1975 effluent from the then Georgia Kraft Co.'s waste water treatment system was diverted to Rocky Creek WWTP and non-contact cooling water was directly discharged to Rocky Creek. Numerous tank overflows and spills were noted from 1975 to the present. The State Hazardous Materials Emergency Response records indicate that the most recent spill occurred on January 18, 1993. A notice of violation was issued in May of 1990 concerning a failure to monitor the effluent discharge. In addition to its NPDES permit, the facility has a permit to operate an industrial on-site landfill. This landfill is constructed with a liner and leachate collection system.

Research also revealed that Armstrong World Industries (Armstrong Cork) at 4520 Broadway in Macon, is listed as a Class II site on the Georgia Hazardous Site Inventory. This site is adjacent to the MNOP west property boundary. The listing is due to the presence of lead in the groundwater at levels above the reportable quantity promulgated by the Hazardous Site Response Act. The Class II designation means the Georgia EPD is requiring more investigation at the site prior to deciding if any remedial action is warranted. Results of investigative efforts on Class II sites are to be forwarded to EPD, and owners are encouraged to clean up the sites during the interim period of EPD's assessment of the findings.

3.3 EVIDENCE OF ENVIRONMENTAL CONDITIONS

Indications of current environmental conditions at the MNOP were sought through review of previous environmental assessments, interviews of knowledgeable authorities, and site reconnaissance.

3.3.1 Previous Environmental Studies

Evidence of environmental conditions at the MNOP exists in the findings of previous environmental assessments summarized in Section 3.1 of this report. Since no further action has yet been undertaken to mitigate the environmental conditions cited by these previous assessments, it is assumed the conditions still exist. A summary of these findings is presented below:

- The Environmental Assessment conducted by Beaver Engineering, Inc. for PB&S consisted of soil sampling in the area of the current property owned by PB&S. The report indicated the presence of elevated levels of heavy metals and trace amounts of volatile organics.

- The ESE investigation involved only the landfill or dump area of the MNOP and a limited portion of the actual production plant known as the Oil Recovery Area. The ESE report concludes that the soil and groundwater contamination discovered on the MNOP site during their investigation "....is reasonably suspected to have resulted from activities that took place during the period of Department of Defense (DOD) control" (ESE 1990). An area of suspected contamination to the west of the landfill site (a discolored pond and abandoned drums) was determined to be off the MNOP, on property owned by Armstrong Cork. This suspected contamination was thought to be the result of activity by parties other than the DOD. A copy of the ESE report is on file and available for review.

- The WEGS investigation was limited to "....a general reconnaissance of the site and groundwater sampling and testing for several compounds." The work was conducted on a portion of the MNOP property which was south of the current Allied Industrial Boulevard and east of the roadway connecting Allied Industrial Boulevard with the south perimeter road. The analysis was limited to groundwater samples from four HydroPunch™ sampling points referred to as monitor wells by WEGS. While the report found that metals contamination was indicated by the analyses from each of the four sampling points, and trichloroethene was detected at two of the four, the report also indicated that no

background levels had been established for the metals. Due to the lack of background levels, no conclusion was made as to whether the metals levels were natural or were an indication of impact from facility operations. It was pointed out that trichloroethene ".... is not a naturally occurring substance in groundwater." The report listed several industrial production-type sources for the metals and the trichloroethene: degreasing, solvents use, metal plating alloys, leaching action of water-flow over metals, paint operations, etc., all of which were conducted during the MNOP operation. A copy of the WEGS report is on file and available for review.

Appendix C contains a copy of the 1992 *Preliminary Assessment Report* (PA) by Georgia EPD for the US EPA, which provides a concise review of assessment information and the only analytical data available up to that date other than the Beaver Engineering, Inc. Environmental Assessment of 1989 (See Section 3.1). The PA contains the analytical data of the ESE and WEGS reports in tabular form. The analytical data will be discussed in more detail in Section 4.0 of this report, which address the areas of further study.

3.3.2 Interviews Of Knowledgeable Authorities

Interviews, beside those conducted to research the records of public agencies, were conducted with Mr. Ralph Ennis, former director of Allied Industrial Park and former employee of MNOP, Maxson, and Allied; and Mr. Tom Yocum, current Projects Manager for MBCIA. Mr. Yocum provided coordination information and supplemental information on the operations of the MNOP since the MBCIA assumed ownership. Mr. Ennis provided direct information as to the operational history of the MNOP facility during its DOD, Maxson, and Allied manufacturing operations. Significant information from the interview of Mr. Ennis and Mr. Yocum on September 13, 1994 is summarized below:

- Reynolds Corporation built and operated the subject site prior to World War II. The Navy assumed operational control in 1941. Mr Ennis was a Navy electrician, and that was his trade with Maxson (1965-73) and with Allied (1973-80). Mr. Ennis went to work as the projects manager for the MBCIA in 1980. Mr. Ennis was in charge of all maintenance during the Allied operations of the MNOP facility and had similar duties during most of his tenure at the facility. To Mr. Ennis' recollection, there were no significant environmental emergencies or spills at the facility during his tenure. With the Navy, there were some minor explosions associated with the ordnance operations.

- Mr. Ennis characterized the Maxson operation of the facility as basically, and "environmentally" the same as when the Navy operated the site.

- Allied purchased the MNOP facility from Maxson to manufacture air bags, but changed to seat belt manufacture when air bag requirements were not legislated. Allied conducted more renovations and improvements to the facility than actual manufacture during the first year of ownership.

- Use of the heat treating and plating facilities of Building 5B continued during Allied's operations. The chrome sludge waste was hauled off site for disposal, but Mr. Ennis did not know specifically where it was sent. Allied purchased a Chevron chrome precipitator and located it in Building 5B; its discharge was routed to the public sewer system.

- Allied never re-activated the on-site, waste-water treatment plant after it was taken out of use, even though using it to treat the chrome sludge was discussed with Georgia DNR in 1977. In or about 1973, Mr. Ennis was in charge of routing all production drains to the sanitary sewer, which heretofore had discharged into the storm sewer. It was indicated by Mr. Yocum that many of the storm sewer drainage outfalls had been covered over during the Allied Industrial Boulevard road construction.

- The facility never generated its own power, according to Mr. Ennis; the boilers were just for heat. Utilities were all underground for lightning protection during the ordnance production tenure, but Allied had all utilities moved above ground. No transformers were underground; they were located at the power houses and in front of every building.

- Building 105 was used primarily for storage until Allied connected the structures for seat belt assembly. Buildings 106, 107, and 108 all were used for explosives manufacture and/or loading and assembly during the Navy/Maxson site tenure. Building 5 was associated with the heavier metals plating and manufacturing operations, with solvent usage and reclamation. Solvents were indicated to have been used by all three owners of the MNOP prior to the MBCIA. Asbestos containing material (ACM) was indicated to exist throughout the utility tunnels at the MNOP and in some buildings. Mr. Yocum indicated Buildings 106, 107, and 7 had some ACM removed.

- Neither Mr. Yocum, nor Mr. Ennis had any knowledge of the possible removal of petroleum contaminated soil form the Oil Recovery Area, which was indicated by previous interviews by others (ESE 1990). Mr. Yocum voiced concern about possible off-site impact from the area near (west of) the landfill, drainage from Armstrong Cork, and drainage from Keebler, which he said had high organic content.

- Mr Ennis indicated the landfill was used by the Navy to detonate explosives, and he also stated that the landfill was used primarily for solid waste consisting of construction and demolition debris, and was not routinely a depository for liquid waste or materials he would consider garbage or hazardous waste. He also indicated that Allied did not use the landfill and spent approximately $10,000 on improvements. Mr. Ennis also indicated he thought other parties used the landfill.

3.3.3 Site Reconnaissance

As noted earlier, RUST E&I personnel have made several visits to the MNOP site over the period of this investigation. No obvious signs of significant environmental conditions were observed during any site visit to the MNOP property, but indications of possible environmental impact and other environmental conditions do exist at the site, as summarized below:

- Debris and other solid waste including roofing shingles and other construction materials, household garbage, demolition debris apparently from the site bunkers and utilities, and at least one abandoned steel UST (estimated 2,000-gallon capacity), were observed at the entrance road to, and within, the site landfill area.

- Pole-mounted transformers are prevalent throughout the MNOP property. Based on interviews, none of these transformers are thought to have been present during the DOD operation of the MNOP; they are believed to have been installed by Allied Corporation. None of the transformers observed during the site reconnaissance appeared to be damaged or leaking. Transformers could be a potential source of polychlorinated biphenyls (PCBs), a regulated substance under the Toxic Substance Control Act (CFR 40.61). Fluorescent lighting observed throughout many of the buildings contains ballasts, any of these installed prior to 1978 may also be a source of PCBs.

- Vent pipes and/or dispensers, indicating the presence of USTs, were observed on the north side of Building 5, on the west side of Building 104, and north of Building 3A.

- Probable sources of asbestos were observed in various suspect, asbestos containing building materials (ACBM) associated with structures on the MNOP property. These consisted of exterior roofing panels, boiler insulation in Building 9, building siding, and possibly the cooling tower panel slats near Building 104. These items were only the most obvious suspect ACBM observed; other ACBM might be identified with a formal asbestos survey.

- Flaking and peeling paint was observed on and in some of the buildings and structures at the MNOP. The date of construction for these buildings would suggest the possibility that this paint may be lead-based.

- Physical signs of possible environmental conditions at the MNOP were observed in the form of significant stains along the north-side loading docks of Building numbers 5 and 105; in the odor near, and appearance of sediments in, flowing water at the site's northeast property corner; in the appearance of sediments in flowing water at the site's adjacent southwest boundary with Armstrong Cork; in the observation of sediment and a slight sheen on water in the landfill area; and the appearance of foam on water under rapid-flow conditions in the area of the landfill.

- Environmental conditions due to impact from off-site sources are possible in that the surrounding area is industrial in nature. Three surface water drainage features were observed on the MNOP site. A drainage swale leading from the north is located on the northwest corner of the site, and flowing water enters the site at both the northeast and southwest corners of the site. As indicated by these surface drainage features, several facilities visible from the MNOP are located upstream and appear to be involved in activities involving solvents, fuels, and other chemical compounds. These include, but are not limited to: Armstrong Cork, several transfer companies, Keebler, Star Chemical, Allegheny Rubber, and Stevens Oil Company. These facilities are all located to the west or north of the MNOP.

3.4 EVALUATION OF NEED FOR FURTHER STUDY

3.4.1 Summary Of Evidence For Potential Contamination

Evidence for potential contamination at the MNOP exists in documented analytical data and in deductions from documented activity and conditions existing at the facility.

Previous environmental assessments of the MNOP, through limited investigative sampling and analysis, have verified the presence of contamination in both soil and groundwater. This contamination exhibits characteristics of the expected MNOP waste stream. These contaminants were discovered in areas outside the areas of concentrated usage or storage of these compounds as well as in the landfill. This would indicate that the contamination may be widespread or a result of inter-plant transportation of materials.

The life expectancy of the structural integrity of steel UST and AST systems in place at the MNOP have been reached or exceeded. Since these systems have been in place for as long as 50 years, there is a significant probability for petroleum releases to have occurred at fittings or in the unprotected metal system components, and/or through the cumulative effect of spillage over the life of the systems.

The equipment and processes in operation at the MNOP were of a nature involving the use of chemical compounds and explosives in large quantities. The potential for loss of some production wastes or finished product to the environment in an operation as massive and complex as that of the MNOP, in an era not as environmentally stringent as today, would be expected to be relatively high.

3.4.2 Summary Of Potential Contamination Source Areas

The confirmation study conducted for the Mobile District USCOE (ESE,1990) indicates production activities with potential for contamination existed at the MNOP in the form of ordnance storage and manufacturing, electrical workings, oil recovery, metal plating, drum storage, explosive loading and powder pouring. The byproducts of these activities were noted to be oils, solvents, and explosives. Their review of inventory records indicated the presence of machinery and operations involving degreasing which would also be expected to produce solvent waste. They noted the existence of the sewage treatment plant, which accepted wastes from a metal plating operation and discharged the treated wastes directly to a swampy area behind the MNOP. A series of USTs and ASTs is also noted in the report as a potential source of contamination. Both the landfill area and the adjacent explosives demolition area were described as being potential sources of contamination having received construction debris, used

parts and explosives. Solvent buildings are also indicated to be potential sources of waste, as are an incinerator and an explosives disposal furnace. A buried cyanide tank in the landfill area is indicated to be a potential source of contamination, but follow-up investigation found an empty container, (ESE, 1990).

The other environmental assessments involving analytical data (Beaver Engineering, 1989 and WEGS 1991) indicated heavy metals in both the soil and in the groundwater. The WEGS study also detected TCE in the groundwater. These were detected in areas within the MNOP production facility area, but were not proximate to any particular production building.

The research conducted by RUST E&I of historic and current conditions at the MNOP indicated that basically two distinct areas of the MNOP property exhibited evidence for being contaminated with hazardous substances or explosives and petroleum constituents. The two areas were identified as the site production area and the site landfill. The sources of potential contamination were numerous and located throughout the site production area north of the Central of Georgia Railroad. This potential source area was deduced to be the result of routine facility operations and not the result of intentional waste deposition. This area might be expected to exhibit relatively widespread contamination of generally low concentrations. The site landfill located south of the railroad, however, does appear to contain contamination which is the result of intentional waste deposition, and may therefore exhibit contamination of a greater quantity and concentration.

3.4.3 Areas Of Further Study

On the basis of the hydrogeologic study presented in Section 2.0 of this report, it was determined that the groundwater movement across the MNOP is to the south, southeast. The discharge area for groundwater crossing beneath the MNOP is the Rocky Creek basin. Therefore, contaminants released in the northern half of the site, which reach groundwater, could potentially be transported to the southern areas of the site or concentrated in the shallow clayey sub-soils at any point south or southeast of their release. This knowledge also points to the possibility of site contamination from off-site properties to the west and north of the MNOP.

Analytical investigation of the soil and groundwater at upgradient northern extremes of the MNOP property may help quantify the potential for contamination from off-site sources, but with respect to on-site sources, the research points to the landfill and the production areas.

The production area of the MNOP consists of that area within the property boundary which was used for the purpose of manufacturing, storing, testing or transporting ordnance and providing support services which were chemical and or petroleum-use intensive. The previously mentioned

metal plating facilities, solvent buildings, UST/AST areas, sewage treatment facility, explosives manufacturing buildings, transformers, storm drain outlets, laboratories, and former oil recovery area, are all part of this production area which exhibits the potential to have released or be releasing contaminants to the environment.

The site landfill of the MNOP is located south of the Perimeter Road and is accessed by a partially graveled roadway. The land parcel containing the landfill is currently owned by the Macon Water Authority. It is said to have been used for deposition of wastes from the MNOP facility, and analytical results have shown the existence of several contaminants including TCE and explosives constituents in soil and groundwater within its boundaries. The sampling and analysis conducted in the landfill have been limited, and no information on the extent of contamination in this area is available.

The following two chapters discuss the production area and the landfill area in detail with respect to their potential for being the primary sources of site contamination at the MNOP. The discussion will summarize the argument for their designation as source areas and provide recommendations for further investigation under the applicable regulatory requirements.

4.0 INDUSTRIAL PARK STUDY AREA

The first of the two areas identified for further study is the area which contains the industrial park. This encompasses the majority of the former MNOP and what is now the Allied Industrial Park. Very little environmental investigation has been conducted in this area to date, however, groundwater and soil impacts have been detected. Several possible sources of groundwater and soil contamination have been identified in the MNOP operations in this area.

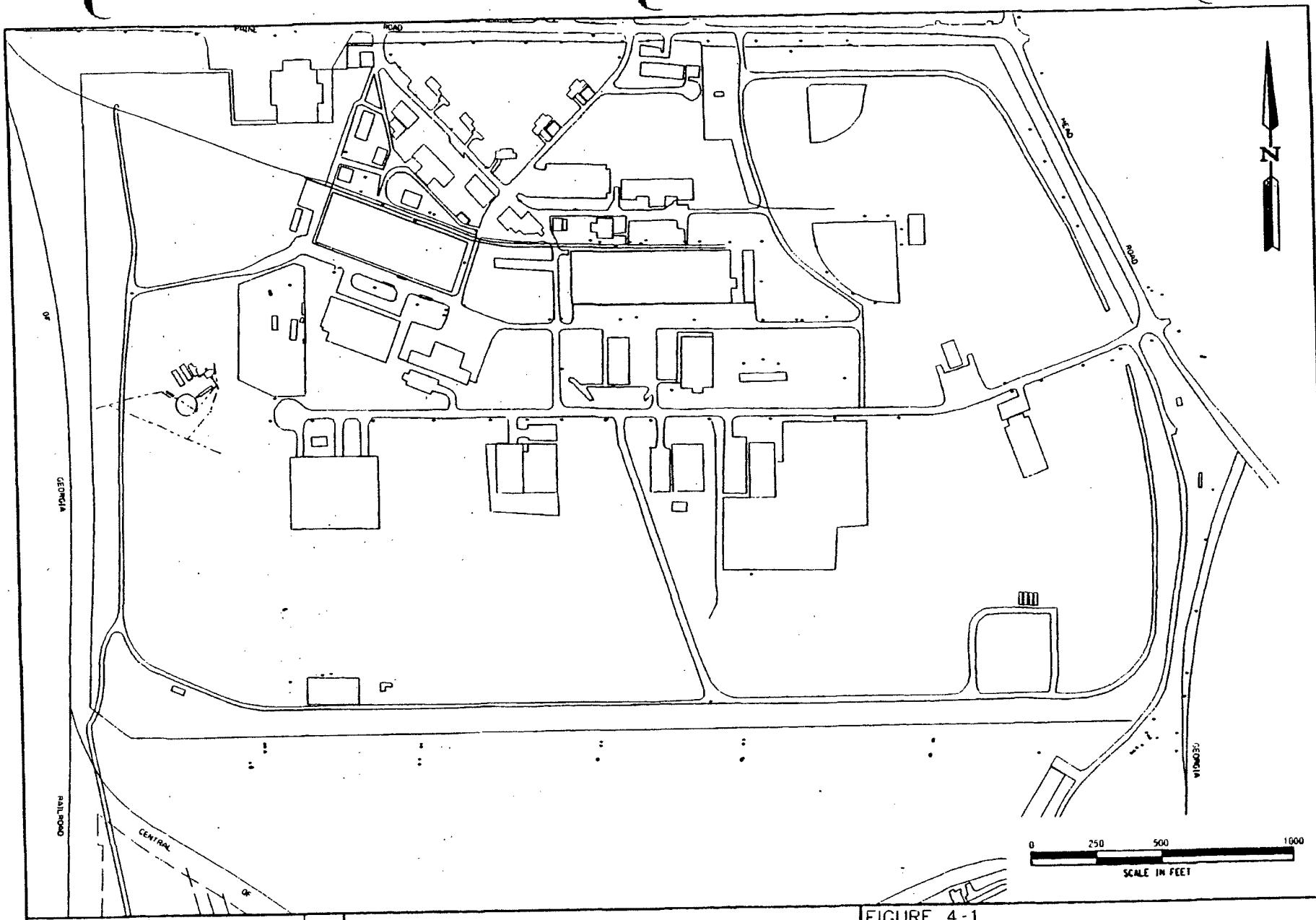
4.1 DESCRIPTION

The industrial park area (Figure 4-1) consists of the northern half of the former MNOP property. Most of this area is bordered by Guy Paine Road to the north, Mead Road to the east, a Central of Georgia railroad track to the west. A small group of buildings used by the MNOP is located just north of Guy Paine Road. The lower end of the site's perimeter road defines the southern end of this area.

Historically, this area encompassed the entire production area of the MNOP. Activities conducted in this area during DOD ownership include the blending and storage of chemicals, metal machining and plating, laboratory operations, and the assembly and storage of ordnance. This area is now known as the Macon-Bibb County Allied Industrial Park. Former MNOP buildings are leased or have been sold for office and light industrial use. The northeast corner of the site contains baseball fields and a pool used by the city of Macon.

The topography of this area slopes downward from the center to both the east and west and from the north to the south (Figure 4-2). Elevations at the northern end of this area range from approximately 375 feet in the center to 350 feet to the east to 320 feet to the west. Elevations at the southern end range from approximately 340 feet in the center to 300 feet to the east and west. The soils in this area are primarily sands mixed with silts and clays. Those areas that do not have buildings or roads are typically overgrown with light vegetation such as bushes and grass.

Engineered components in this area include roads, sewers, buildings, and support components used both by the MNOP and current occupants. Several components from the MNOP have been identified as possible sources and/or conduits for contamination. These include the metal plating facilities, the oil recovery area, the abandoned sewage treatment plant, storm drain outfalls, above ground and underground storage tanks, electrical transformers, and the explosives manufacturing area.



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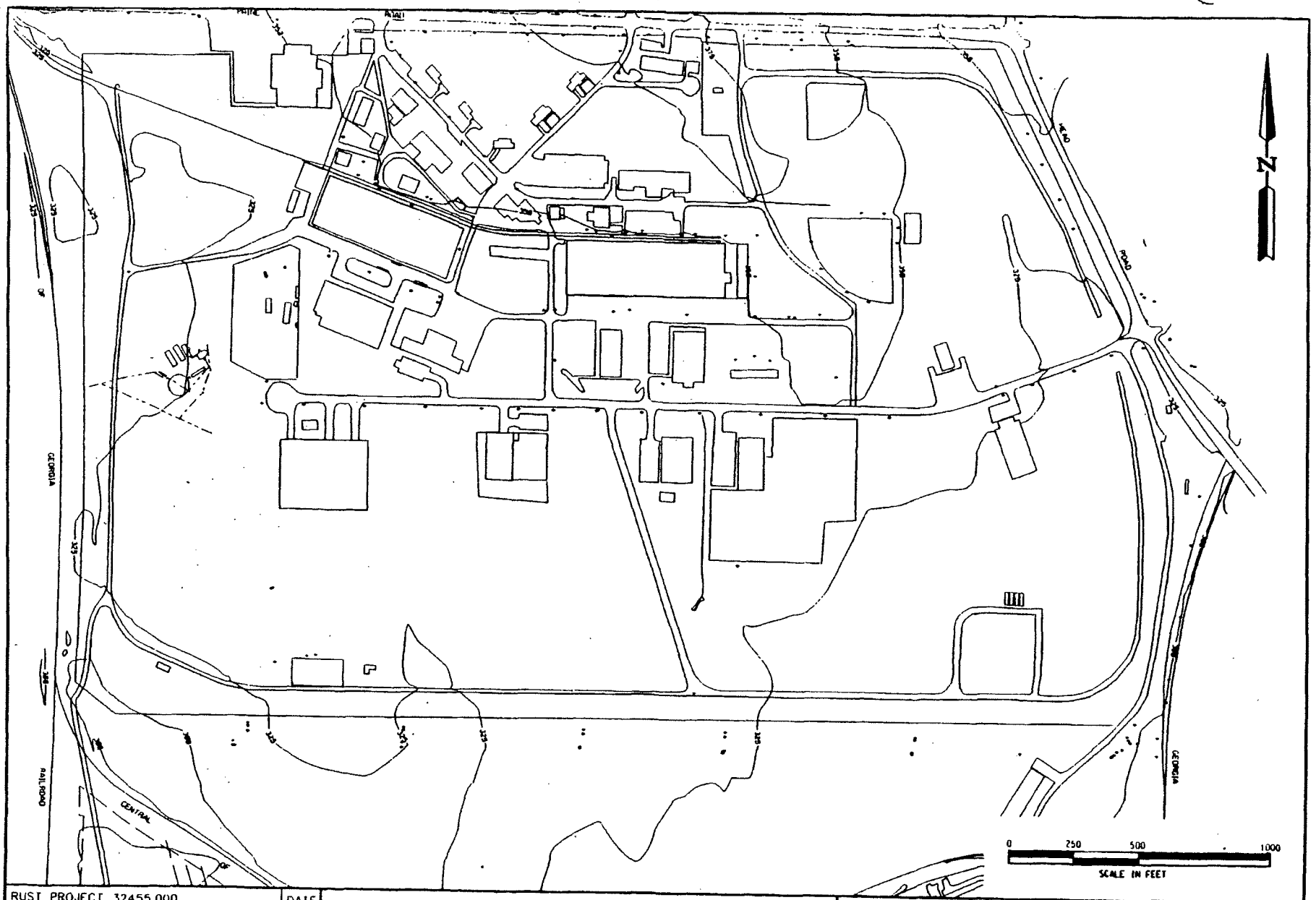
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-1
INDUSTRIAL PARK STUDY AREA
TRANSFORMERS AT POWER HOUSES
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



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RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-2
SITE TOPOGRAPHIC MAP
TRANSFORMERS AT POWER HOUSES
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

The metal plating facilities used cyanide, chrome sludge, solvents, acid baths, caustic baths, and hydraulic oil. In the oil recovery area, metal shavings were centrifuged to remove excess oils. The removed oils were reportedly allowed to drain to the ground. The abandoned sewage treatment plant was designed to only handle sewage generated by the ordnance plant, however, it is possible that chemicals used in the ordnance plant were disposed of in drains that went to the sewage plant.

Storm water drain outfalls were located throughout this area. Interviews with former MNOP employees indicate that liquid wastes from production areas may have been discharged to the storm drains. The above ground and underground storage tanks are possible sources of petroleum contamination. Electric transformers, which were located throughout the site, may be potential sources of PCBs. The explosives manufacturing area is a potential source of pentaerythritoltetranitrate (PETN), 2,4-dinitrotoluene (2,4-DNT) and 1,3-dintrobenzene (1,3-DNB).

4.2 WASTE CHARACTERIZATION

No specific records of waste disposition have been discovered in the research thus far conducted for this project. The wastes generated by the MNOP have been characterized in the previous environmental assessments through speculation of derivatives from the production operations known to have been conducted. Since the beginning of production of ordnance at the plant by the Navy and Maxson, through the production of seat belts by Allied Chemical, many of the basic operational wastes have remained the same. The primary exception to this is the generation of explosives constituents waste, which Allied Chemical would not be expected to have produced in their operations.

The inventory lists prepared by the Navy for the sale of assets to Maxson in 1965, were reviewed at the National Archives in East Point, Georgia. One of these lists labeled as the "Housekeeping Items", listed small equipment, parts, and supplies. A section of this list, consisting primarily of chemicals, indicated there were 35 drums (no size was specified; assumed 55-gallon drums) of trichlorethylene on-hand at the time of the property transfer to Maxson. Other chemicals, as well as paint, solvents, cleaners, and automotive parts were included on the list in primarily small quantities. This list provides an indication of the types of common-use materials that might have been expected to make up the base waste stream.

During the period of Navy operation, the by-product wastes of the MNOP would characteristically be considered to be of three types: domestic sewage, manufacturing wastes, and solid waste consisting of putrescible waste and construction debris. These three waste types were likely disposed in one of five ways: 1) the domestic sewage as well as some manufacturing

wastes were routed to the on-site Waste Water Treatment Plant, 2) some production wastes were disposed in the storm-sewer system because construction plans show the system to have been connected to areas within some manufacturing facilities and metal plating floor drains and sinks, as well as building exteriors and product transport pathways, 3) at least some of the solid waste and all domestic garbage is indicated to have been disposed of off-site by commercial or public services, 4) some of the solid waste, explosives, and construction debris is known to have been disposed of in the site landfill, and based on the common practices of the time, any of the facility by-products could have ended up in the landfill, and 5) some waste is assumed to have been lost to the environment via negligence or human error during Navy ownership, and therefore isolated indications of facility by-products could be found in remote or non-production areas as well as production areas.

The area surrounding the MNOP property is industrial in nature. A sub-contract database search of environmentally regulated facilities within a one-mile radius of the MNOP was conducted for RUST E&I by Environmental Data Resources, Inc. (EDR). The search revealed four Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) facilities, four leaking underground storage tank (LUST) incidents, 26 registered underground storage tank (UST) facilities, ten Resource Conservation and Recovery Information System (RCRIS) listings, one PCB Activity Database (PADS) listing, 14 Facility Index System (FINDS) listings, three Toxic Release Inventory (TRIS) records, and 2 Toxic Substance Control Act (TSCA) listings. The four CERCLIS listings include the MNOP property under the Allied Chemical Corporation name at 600 Guy Paine Road and the property east of the MNOP at the 4652 Mead Road site. CERCLIS contains information on sites identified by the USEPA as abandoned, inactive or uncontrolled hazardous waste sites which may require cleanup. The other two CERCLIS sites as well as the site at 4652 Mead Road, were designated as having been assessed, requiring no further investigation, and as having had no hazard identified. The 600 Guy Paine Road site status is shown as being currently under investigation. A complete copy of the EDR report is provided in Appendix D.

No conclusion can be drawn as to what extent the surrounding properties might impact the environmental regime of the MNOP property without conducting further research and site investigation. However, several of the facilities listed in the EDR report appear to be in an upgradient position to the MNOP site, and therefore the potential for impact from these sites can not be totally discounted. There are ten UST sites in apparent upgradient position to the MNOP site and within approximately one-quarter mile of its northwestern boundary. Three of these sites are just across Guy Paine Road from the MNOP site. At least one site was visually identified to be adjacent to a drainage swale which enters the MNOP site at its northwest corner.

4.2.1 Evidence of Releases

Environmental samples have been collected from this study area on three previous occasions. Soil sampling showed detectable quantities of metals, organics, PETN, and petroleum hydrocarbons. Groundwater samples contained metals and trichloroethene (TCE). It should be noted that no applicable background samples were reported, and only limited quality control sample results were reported in any of the sampling events.

In 1989, an environmental assessment was conducted by Beaver Engineering in the vicinity of the PB&S Chemical facility. The general area of this assessment is shown in Figure 4-3. Eight soil samples were collected from each of four quadrants designated in the area. The eight samples from each quadrant were combined into one composite sample per quadrant. Various metals were detected, along with methylene chloride, bis-(2-ethylhexyl)-phthalate and chloroform (Table 4-1).

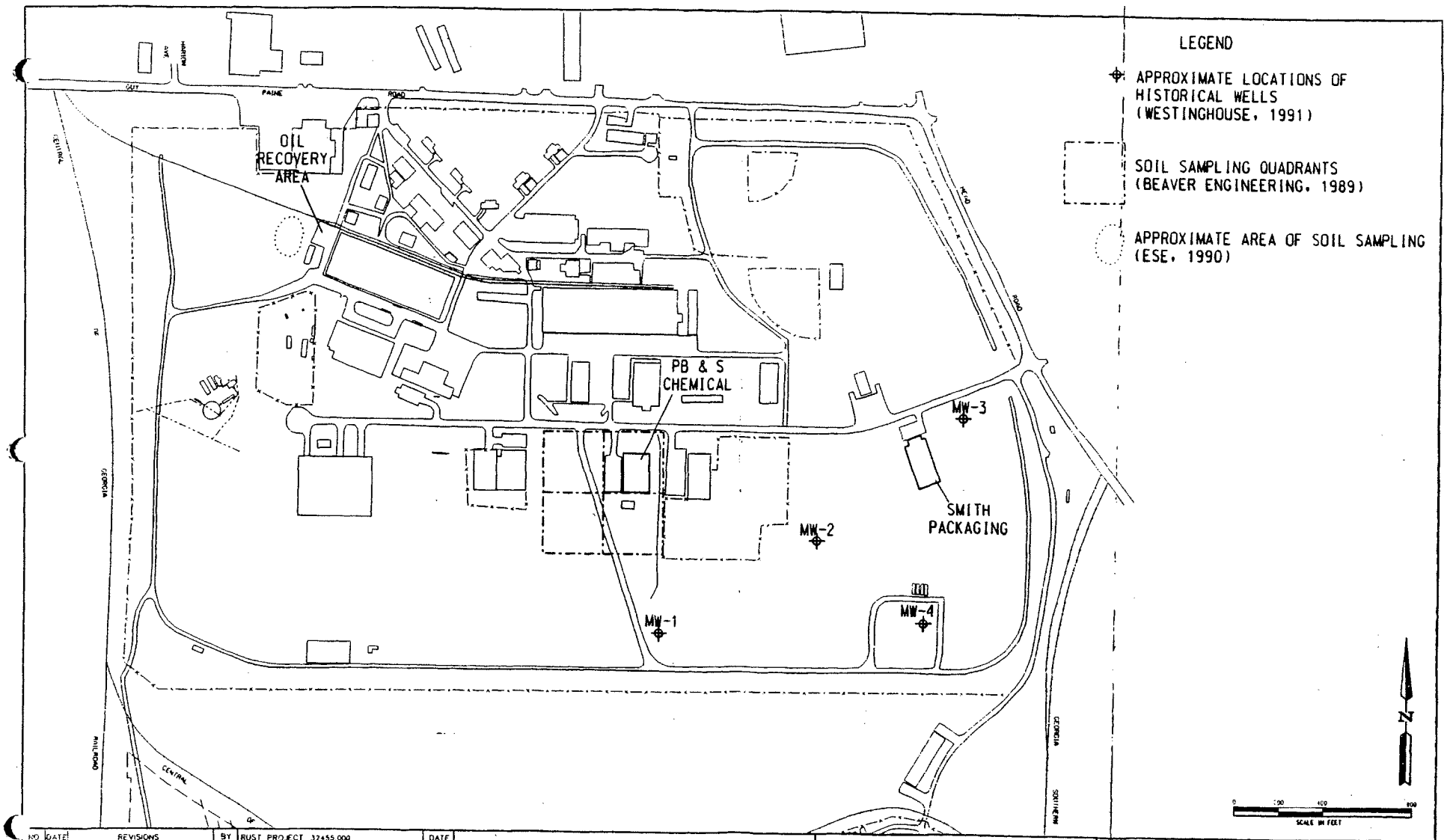
In 1990, Environmental Science and Engineering, Inc. (ESE) collected two shallow soil samples from a flat drainage area immediately below the MNOP's oil drainage area. One composite soil sample was made from the soils collected. This soil sample contained detectable quantities of arsenic, barium, cadmium, chromium, lead, PETN, and petroleum hydrocarbons (Table 4-2). Although the ESE report indicates obvious stained soils and stressed vegetation in this area, these were not apparent during RUST's site reconnaissance in 1994. The general area of this assessment is shown in Figure 4-3.

Westinghouse Environmental and Geotechnical Services performed a preliminary environmental investigation in 1991. During this investigation, four groundwater samples were collected using a HydroPunch™ sampling tool near the current Smith Packaging facility. Westinghouse reported that barium, chromium, lead, iron, manganese, aluminum, and trichloroethene were detected in the samples (Table 4-3). The general area of this assessment is shown in Figure 4-3.

The site reconnaissance conducted by RUST E&I revealed physical evidence for potential impacts originating from off-site sources. Sediment, as evidenced by a grayish-white covering on submerged surfaces in the water, was flowing onto the site in the ditch located on the northeast corner of the property. The ditch was observed at the culvert crossing the perimeter road north of the ballfields on the site. A slight, unidentifiable odor was detected here.

4.2.2 Contaminants of Concern

Since most every operation that was conducted at the MNOP took place in the industrial park area, it is possible that any chemical used and/or manufactured by the plant could have been



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RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-3
PREVIOUS ENVIRONMENTAL STUDIES
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

Table 4-1
Beaver Engineering Sampling Results
Industrial Park Study Area
Former Macon Naval Ordnance Plant

Analyte	NW Quad	NE Quad	SW Quad	SE Quad
Arsenic	10.7	8.89	6.93	6.85
Barium	17.2	16.5	32.7	18.6
Chromium	13.6	14.4	9.61	13.7
Lead	9.1	9.33	12.8	9.53
Mercury	0.09	0.08	0.2	0.07
Selenium	0.63	0.47	0.44	0.41
Silver		0.4	0.53	
Methylene Chloride	0.2	0.1		1.17
Tetrachloroethane		<0.03		
Chloroform		0.035		
Ethylbenzene		<0.03		
Toluene		<0.03		
bis(2-Ethylhexyl)phthalate	0.6		<0.5	1.8

All results are shown in mg/kg.

Table 4-2
ESE Sampling Results
Industrial Park Study Area
Former Macon Naval Ordnance Plant

Analyte		SD-2	SD-2 Dup
Arsenic	mg/kg	1.87	1.84
Barium	mg/kg	30.4	27.0
Cadmium	mg/kg	0.657	0.766
Chromium	mg/kg	12.9	13.6
Lead	mg/kg	22.6	26.9
PETN	mg/kg	4.92	6.1
Petroleum Hydrocarbons	ug/g-dry	12,600	12,200

Table 4-3
Industrial Park Study Area
WEGS Sampling Results
Former Macon Naval Ordnance Plant

Analyte		MW-1	MW-2	MW-3	MW-4
Aluminum	ppm	179	65.1	737	62.5
Barium	ppm	-	-	1.46	-
Chromium	ppm	7.18	0.6	0.85	0.09
Lead	ppm	0.31	-	0.82	-
Iron	ppm	106	56.7	104	47.2
Manganese	ppm	1.31	0.38	3.34	0.55
Trichloroethene	ppb	-	22	-	62

ppm = parts per million
ppb = parts per billion

released to the environment. However, based on the historical research and the previous environmental investigations, a preliminary list of contaminants of concern has been developed. These contaminants are shown in Table 4-4.

This list is based on what may have been released to the environment during the operation of the MNOP, and what constituents have been detected in the previous environmental investigations. It should be noted that some of these contaminants have not yet been detected at the site, and for those that have, very little quality control or background information is available. It is expected that some constituents will be removed and others added to this list after more complete investigative sampling results are obtained.

4.2.3 Waste Characteristics

The following waste characteristics were obtained from the Handbook of Toxic and Hazardous Chemicals and Carcinogens, Third Edition (Sittig, 1991), the Handbook of Environmental Fate and Exposure Data (Howard, 1990), and the NIOSH Pocket Guide to Chemical Hazards (NIOSH, 1990). Hazardous substances, hazardous wastes, priority pollutants, and toxic chemicals are EPA designations for those contaminants. Those listed as carcinogens have been identified as such by the U.S. National Toxicology Program. The characteristics of each identified contaminant are summarized below.

Aluminum is a toxic chemical which is insoluble in water. The primary route of entry is inhalation.

Arsenic is listed as a carcinogen, hazardous substance, hazardous constituent waste, priority pollutant, and toxic chemical. It is insoluble in water. Primary routes of entry are inhalation, absorption, and ingestion.

Barium is a hazardous constituent waste and a toxic chemical. Primary routes of entry are inhalation, ingestion, and skin or eye contact.

Cadmium is a carcinogen, hazardous substance, hazardous constituent waste, priority toxic pollutant, and toxic chemical. It is insoluble in water. Primary routes of entry are inhalation and ingestion.

Chromium is a carcinogen, hazardous substance, priority pollutant, and toxic chemical. Primary routes of entry are inhalation, ingestion, and skin and eye contact.

Table 4-4
Contaminants of Concern
Industrial Park Study Area
Former Macon Naval Ordnance Plant

Contaminant	CAS
1,3-Dinitrobenzene	99-65-0
2,4-Dinitrotoluene	121-14-2
Aluminum	7429-90-5
Arsenic	7440-38-2
Barium	7440-39-3
bis(2-Ethylhexyl)phthalate	117-81-7
Cadmium	7440-43-9
Chloroform	67-66-3
Chromium	7440-47-3
Cyanide	57-12-5
Ethylbenzene	100-41-4
Iron	7439-89-6
Lead	7439-92-1
Manganese	7439-96-5
Mercury	7439-97-6
Methylene Chloride	75-09-2
PCBs	various
PETN	115-77-5
Petroleum Hydrocarbons	N/A
Selenium	7782-49-2
Silver	7440-22-4
1,1,2,2-Tetrachloroethane	79-34-5
Toluene	108-88-3
Polycyclic Aromatic Hydrocarbons (PAH)	various
Trichloroethene	79-01-6

Cyanide is listed as an extremely hazardous substance, a hazardous waste, priority pollutant, and toxic chemical. Primary routes of entry include inhalation, skin absorption, ingestion, and eye and skin contact.

Ethylbenzene is a hazardous substance, priority pollutant, and toxic chemical. Primary routes of entry include inhalation, ingestion, and eye and skin contact. Ethylbenzene has some tendency for soil and sediment adsorption, but more likely will leach to groundwater. Under natural conditions, biodegradation is slow in soil, but rapid in water. No significant bioaccumulation is noted.

Bis(2-ethylhexyl)phthalate is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary routes of entry are inhalation, ingestion, and skin and eye contact.

Chloroform is a carcinogen, extremely hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary routes of entry are inhalation, ingestion, and skin and eye contact. Releases of chloroform to soils will leach into groundwater. Biodegradation may be slow. Adsorption to sediment and bioaccumulation are not significant. In concentrated form will react violently with chemically active metals such as aluminum or magnesium powder.

Dinitrobenzene is a hazardous substance and hazardous waste constituent. Primary routes of entry are inhalation, ingestion, skin and eye contact, and percutaneous absorption of liquid.

2,4-Dinitrotoluene is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary routes of entry are inhalation, ingestion, skin and eye contact, and percutaneous absorption of liquid. 2,4-Dinitrotoluene is slightly mobile in soil, and may biodegrade in both aerobic and anaerobic soil zones. It will have a slight tendency to sorb to sediments, and will not bioconcentrate in aquatic organisms.

Iron is a toxic substance, it is insoluble in water, and is heavier than water. The primary route of entry into the body is through dust inhalation.

Lead is a hazardous substance, priority pollutant, and toxic chemical. Primary entry routes include ingestion, inhalation, and skin and eye contact.

Several different compounds are defined as polycyclic aromatic hydrocarbons. Toxicity data are available for benzo(a)pyrene and benzo(b)flouranthene. Both of these PAHs are carcinogens, hazardous substances, hazardous wastes, and priority pollutants. Primary entry routes are inhalation and ingestion, and skin absorption when contacted by soil or oil containing "high

concentrations" (defined in the reference as those concentrations found "at a hazardous waste site").

Manganese is a toxic chemical. Primary routes of entry include inhalation, ingestion, and percutaneous absorption of liquids.

Mercury is a hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary entry routes include inhalation, skin absorption, and eye and skin contact.

Petroleum hydrocarbons is a generic name for aliphatic and nonhalogenated hydrocarbons. Petroleum hydrocarbons are not water soluble. Primary exposure routes may be skin absorption or inhalation.

Polychlorinated Biphenyls (PCBs) are potential human carcinogens, hazardous substances, hazardous wastes, and toxic chemicals. PCBs are not water soluble, heavier and will sink in water. The primary route of exposure is skin absorption.

Selenium is a hazardous substance, priority pollutant, and toxic chemical. Primary entry routes include inhalation, percutaneous absorption of liquid, ingestion, and eye and skin contact.

Silver is a priority pollutant and toxic chemical with inhalation, ingestion and eye and skin contact as the primary entry routes.

Trichloroethene is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary entry routes include inhalation, percutaneous absorption of liquid, ingestion, and eye and skin contact. When released to soil, TCE will leach quickly to groundwater. While some biodegradation may occur, it will be slow. Adsorption to sediments and bioaccumulation are not significant.

Methylene chloride is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary entry routes include inhalation, percutaneous absorption of liquid, ingestion, and eye and skin contact.

1,1,2,2 Tetrachloroethane is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary entry routes include inhalation, absorption through the skin, ingestion, and eye contact. It is highly mobile in soil, leaching into groundwater and biodegradation is slow. Bioaccumulation is not significant for 1,1,2,2 tetrachloroethane.

Toluene is a hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Its primary entry routes include inhalation, percutaneous absorption of liquid, ingestion, and eye and skin contact. When released to soil, toluene will tend to leach to groundwater. Biodegradation will occur slowly in both soil and groundwater. Adsorption to sediment and bioaccumulation are not significant.

No significant health effects are associated with exposure to pentaerythritoltetranitrate, even at abnormal use concentrations.

4.3 HEALTH AND ENVIRONMENTAL ASSESSMENT

Based on the potential sources and the characteristics of the contaminants of concern for the industrial park study area; soil, groundwater, surface water and sediments are the primary migration pathways. Any releases of contaminants to the environment in this area by the MNOP would probably have been to the soil or air. However, any MNOP releases to the air would have long since dispersed or degraded. Possible releases from off-site properties may impact the site through surface water and sediments, and groundwater flowing into this study area.

The inorganic contaminants generally have low solubility in water, and the tendency to stay in soils. The organics are more soluble in water when compared to the inorganics and would tend to be more mobile and likely to leach into the groundwater and/or volatilize. These pathways are confirmed by the previous environmental studies conducted at the site, where contamination has been identified in both soil and groundwater.

For the contaminants listed, the most often cited routes of entry were ingestion, inhalation, and skin and eye contact. Therefore, the exposure pathways of concern would be those which provide direct contact with the soil, groundwater, surface water, and sediments.

There are many potential exposures to surface soil in this area. The current employees at the industrial park have the potential for regular contact with surface soil. Since parts of this area in the northeast corner of the MNOP were formerly used for ordnance assembly, storage and testing, and are now owned by the City of Macon and are also used for recreational activities, the potential exists for exposure of both children and adults to potentially contaminated soil, surface water and sediments.

No potable water supply wells have been identified at or near the site, so direct ingestion or contact with any contaminated groundwater is unlikely. However, one production well is operating in this area for industrial supply water. A second is being installed. Its use is not currently defined. The use of this water in a production environment may present some

incidental and/or secondary contact with the groundwater. These two wells are both almost 300' deep, and it is quite possible that they are not extracting groundwater which has been impacted by the site.

4.4 REGULATORY REQUIREMENTS

This study area is currently on Georgia's Hazardous Site Inventory (HSI). This places it under Hazardous Site Response Act (HSRA) regulations. This area is being considered for inclusion on the National Priority List. For the purposes of this section, it is assumed that the HSRA rules are the applicable or relevant and appropriate requirements (ARARs) for the site.

The HSRA rules (Chapter 391-3-19) require that Georgia EPD be notified of any releases of regulated substances which:

- cause the concentration of the regulated substance in groundwater to exceed the naturally-occurring background concentration,
- cause the concentration of the regulated substance in soil to exceed the concentrations published in Appendix I of the rules, or
- are due to the discarding or abandonment of a regulated substance in containers, tanks, or vessels.

Of the contaminants of concern listed in Table 4-4, only aluminum, iron, manganese, PETN, and petroleum hydrocarbons are not regulated substances under HSRA. At this time, there is no known discarding of regulated substances in this area. The HSRA reporting levels applicable for the identified contaminants of concern are shown in Table 4-5.

Action levels under HSRA are not determined by specific concentrations, but are calculated using the Reportable Quantity Screening Method (RQSM). The RQSM is calculated for each regulated substance which has had a reportable release in either soil or groundwater. A RQSM score of 10 for the groundwater pathway or 20 for the on-site (soil) pathway would place the site on the HSI.

Once a site is on the HSI, the responsible party must issue a compliance status report which documents the extent and source of the contamination, any human and environmental receptors, previous or proposed corrective actions, and the site's compliance with the risk reduction standards defined in the HSRA rules. Compliance with the Type 1, 2, 3, or 4 risk reduction standards qualifies the site for removal from the HSI.

Table 4-5
HSRA Limits
Industrial Park Study Area
Former Macon Naval Ordnance Plant

Constituent	CAS	Reporting Limit	Clean Up Levels Groundwater	Soil
1,3-Dinitrobenzene	99-65-0	1.05	0.001 A	1.05 C
2,4-Dinitrotoluene	121-14-2	0.66	0.00005 A	0.66 C
Aluminum	7429-90-5	N/A	N/A	N/A
Arsenic	7440-38-2	41	0.05	20
Barium	7440-39-3	500	2	1000
bis(2-Ethylhexyl)phthalate	117-81-7	50	0.006	50 C
Cadmium	7440-43-9	39	0.005	2
Chloroform	67-66-3	0.68	0.1 B	10 C
Chromium	7440-47-3	1200	0.1	100
Cyanide	57-12-5	10	0.2	10 C
Ethylbenzene	100-41-4	20	0.7	70 C
Iron	7439-89-6	N/A	N/A	N/A
Lead	7439-92-1	300	0.015	75
Manganese	7439-96-5	N/A	N/A	N/A
Mercury	7439-97-6	17	0.002	0.5
Methylene Chloride	75-09-2	0.08	0.005	0.5 C
PCBs	various	1.55	0.0005	1.55 C
PETN	115-77-5	N/A	N/A	N/A
Petroleum Hydrocarbons	N/A	N/A	N/A	N/A
Selenium	7782-49-2	36	0.05	2
Silver	7440-22-4	10	0.1	2
1,1,2,2-Tetrachloroethane	79-34-5	0.13	0.0002 A	0.13 C
Toluene	108-88-3	14.4	1	100 C
Trichloroethene	79-01-6	0.13	0.005	0.5 C

Notes:
All groundwater concentrations are in mg/L.
All soil concentrations are in mg/kg.
A = Level is below the available detection limit.
B = Total trihalomethanes total concentration.
C = Lower values may be required based on a risk assessment.

Clean up levels under HSRA rules are dependent on which risk reduction standard is met. The most likely standard for this area would be Type 3, which is based on standard exposure assumptions and defined risk levels for non-residential use properties. Clean up levels defined in the rule appendices are listed in Table 4-5.

4.5 RECOMMENDATIONS

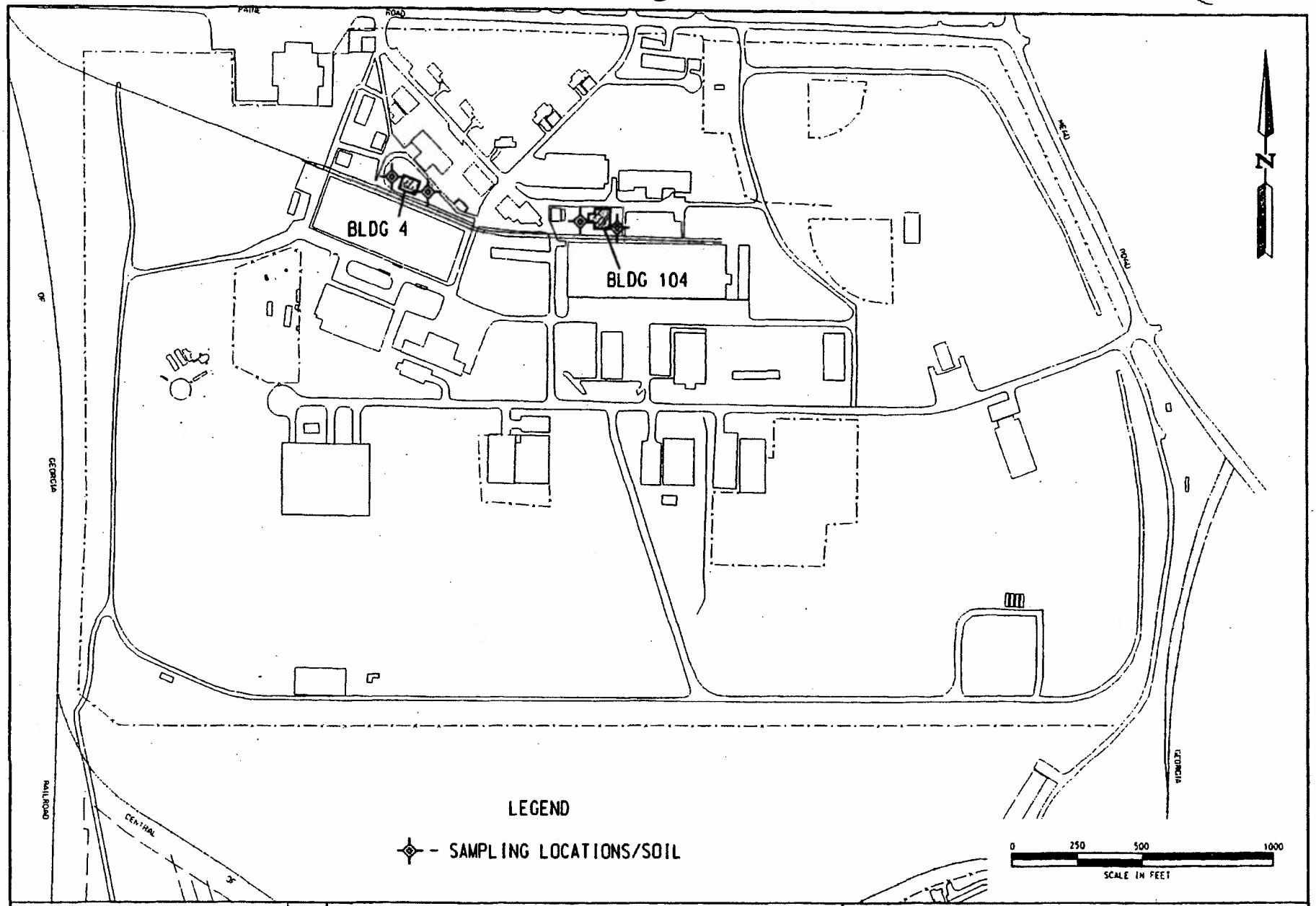
4.5.1 Field Investigation Plan

This section is intended to provide an overview of what sampling is needed in this study area and the rationale for it. At this time, the sampling schemes discussed in this report should be considered minimum sampling requirements. As a separate submittal for this project, RUST E&I is preparing a detailed scope of work for the sampling to be performed in this study area. This scope of work may include additional sampling requirements.

Five independent sampling efforts should be conducted for this study area. These sampling events should address contamination due to general plant operations, PCBs from transformers, explosives handling, possible off-site impacts, and petroleum contamination from storage tanks and the oil recovery area. Sample locations, depths, and analytical tests will be separate for each event.

Contamination from the general plant operations could potentially include releases of almost any chemical used at the MNOP. This sampling will be the most comprehensive in terms of area covered and analytical testing. Specific sources of contamination which may have released contaminants to the environment are the storm drain outfalls, the former sewage treatment plant, and the metal plating facilities. Groundwater and soil samples should be collected at the locations shown in Figure 4-4. These locations include four background locations. All samples should be analyzed for Target Compound List (TCL) volatile and semi-volatile organics and Target Analyte List (TAL) metals. These lists of analytes include all of the contaminants of concern listed in Table 4-4.

During MNOP operations, electrical transformers were reportedly located in buildings 4 and 104 (Figure 4-5), and later in front of most other main buildings. There are currently no indications of where transformers may have been located near the other buildings. However, if PCB contamination is present at the site, buildings 4 and 104 would be very likely locations. Therefore, soil samples should be collected from these buildings and analyzed for PCBs. Soil samples for PCBs should be collected in the first 5 feet of soil. Unless an inspection of the inside of the buildings indicates a likely place for oil leaks to go, the samples should be collected immediately downgradient of the building.



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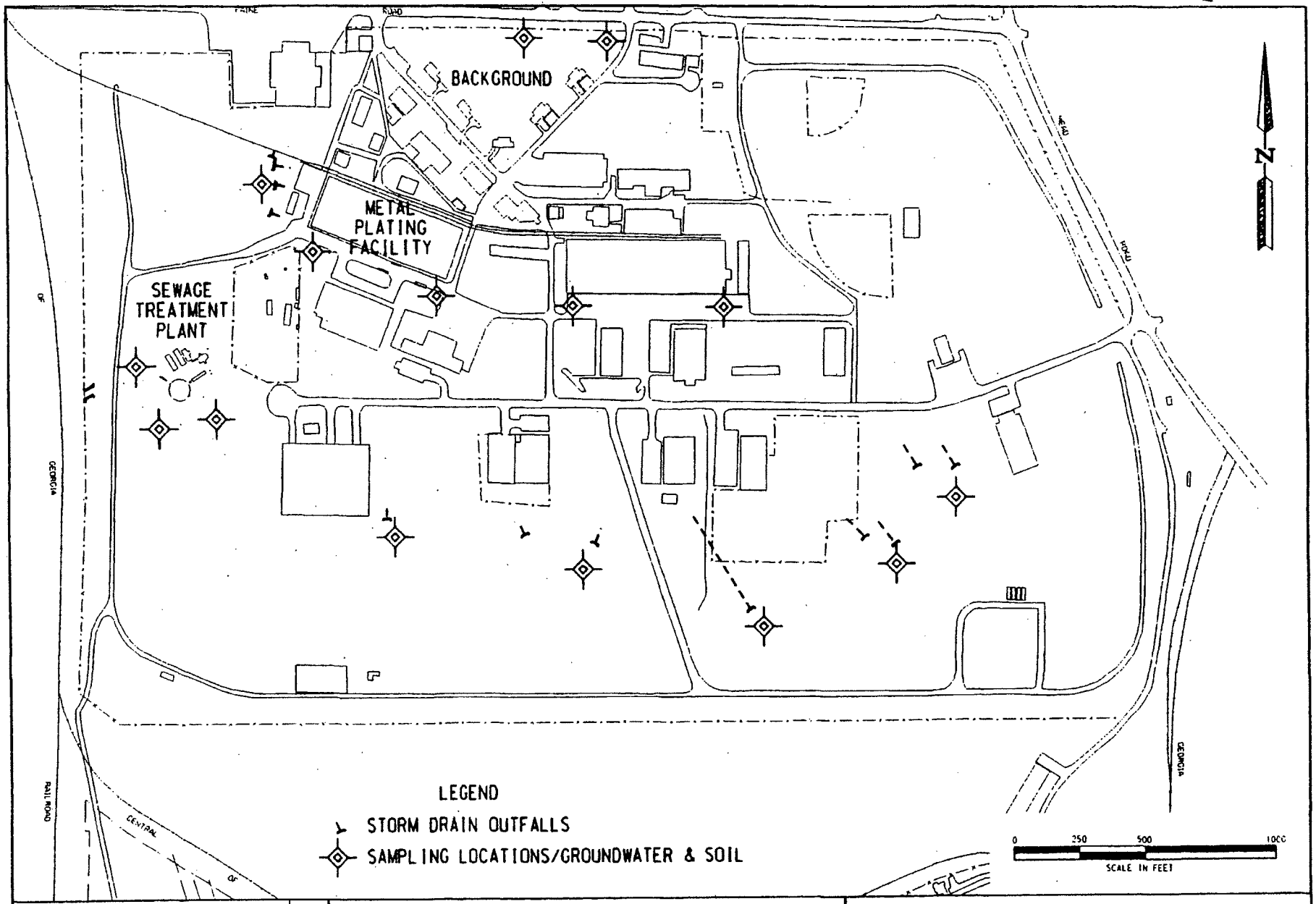
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-5
PROPOSED PCB SAMPLING LOCATIONS
TRANSFORMERS AT POWER HOUSES
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



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RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-4
PLANT OPERATIONS SAMPLING LOCATIONS
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

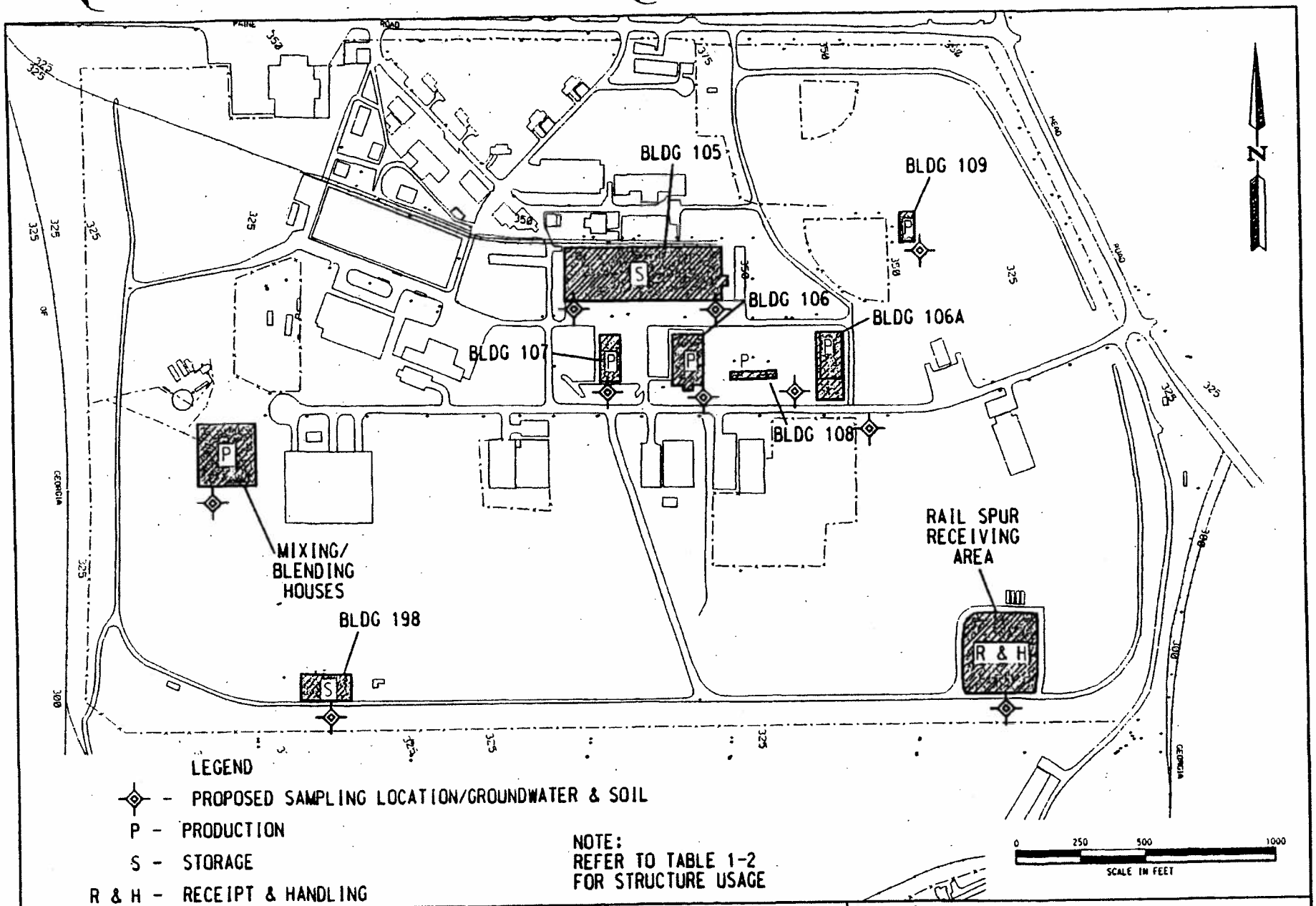
Explosive compounds were either handled or stored at many areas around the industrial park including numerous small dryer buildings, ordnance magazines, and blending and weighing houses. Seven buildings and two handling areas have been identified as primary explosives production sites (Figure 4-6). These sites are the most likely sources of any explosives contamination due to the increased handling required by production operations. The seven buildings are: 105, 106, 106A, 107, 108, 198, and 109. The two handling areas noted are the receipt and handling area at the southeast railroad spur and the area of the four mixing and blending houses (38, 38A, 39, 40) in the southwest area of the ordnance plant. Groundwater and soil samples should be collected immediately downgradient from these buildings and analyzed for 2,4-DNT and 1,3-DNB, and PETN.

Off-site sources may be impacting this study area. The most likely pathway would be the drainage coming into the site via the flowing stream at the northeast corner of the site. The drainage swale at the northwest corner of the site may also be a factor during storm events. Surface water and sediment samples should be collected from these areas and analyzed for the TCL/TAL suite of analytes (see Figure 4-7).

Petroleum-related contamination could be located at each underground and above ground storage tank location and at the oil recovery area. Soil and groundwater samples should be collected at these locations and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) and petroleum hydrocarbons. Figure 4-8 shows the approximate locations of the underground and above ground tanks, the oil recovery area, and the associated sampling points. No sample points are proposed for the area around the above ground tank formerly located at building 202. However, two sample points along the northern property boundary should be sampled for BTEX and petroleum hydrocarbons to assess the potential contamination from the building 202 property.

At all borings except PCB borings, soil samples should be collected every five feet from the top of the boring to the top of the water table. These samples should be stored in glass jars and analyzed in the field for headspace organics using field instrumentation. The sample with the highest reading should be selected for laboratory analysis. Groundwater samples at each boring should be collected from the top of the water table. In order to reduce sampling costs and time, the use of "direct push" technology is recommended for all groundwater and soil sampling.

The results of these sampling events will be sufficient to establish the presence of the contamination in the most likely locations in this area. These results should be enough to determine the regulatory status of this area, and what, if any, additional actions are necessary. Possible actions could include determining the lateral and vertical extent of contamination, more



LEGEND

- ⊕ - PROPOSED SAMPLING LOCATION/GROUNDWATER & SOIL
- P - PRODUCTION
- S - STORAGE
- R & H - RECEIPT & HANDLING

NOTE:
REFER TO TABLE 1-2
FOR STRUCTURE USAGE

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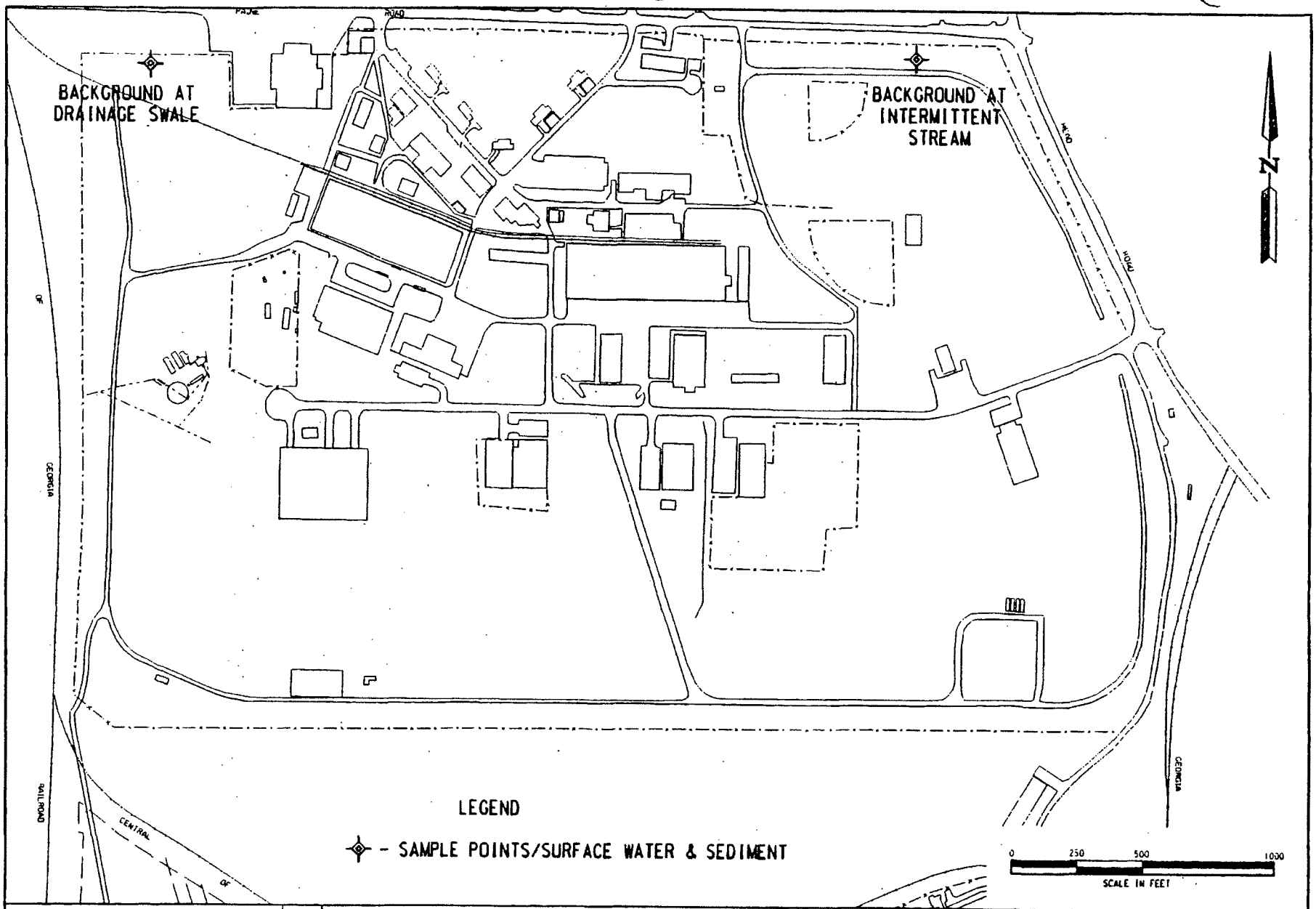
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-6
PROPOSED EXPLOSIVES SAMPLING LOCATIONS
EXPLOSIVES HANDLING & MANUFACTURING
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



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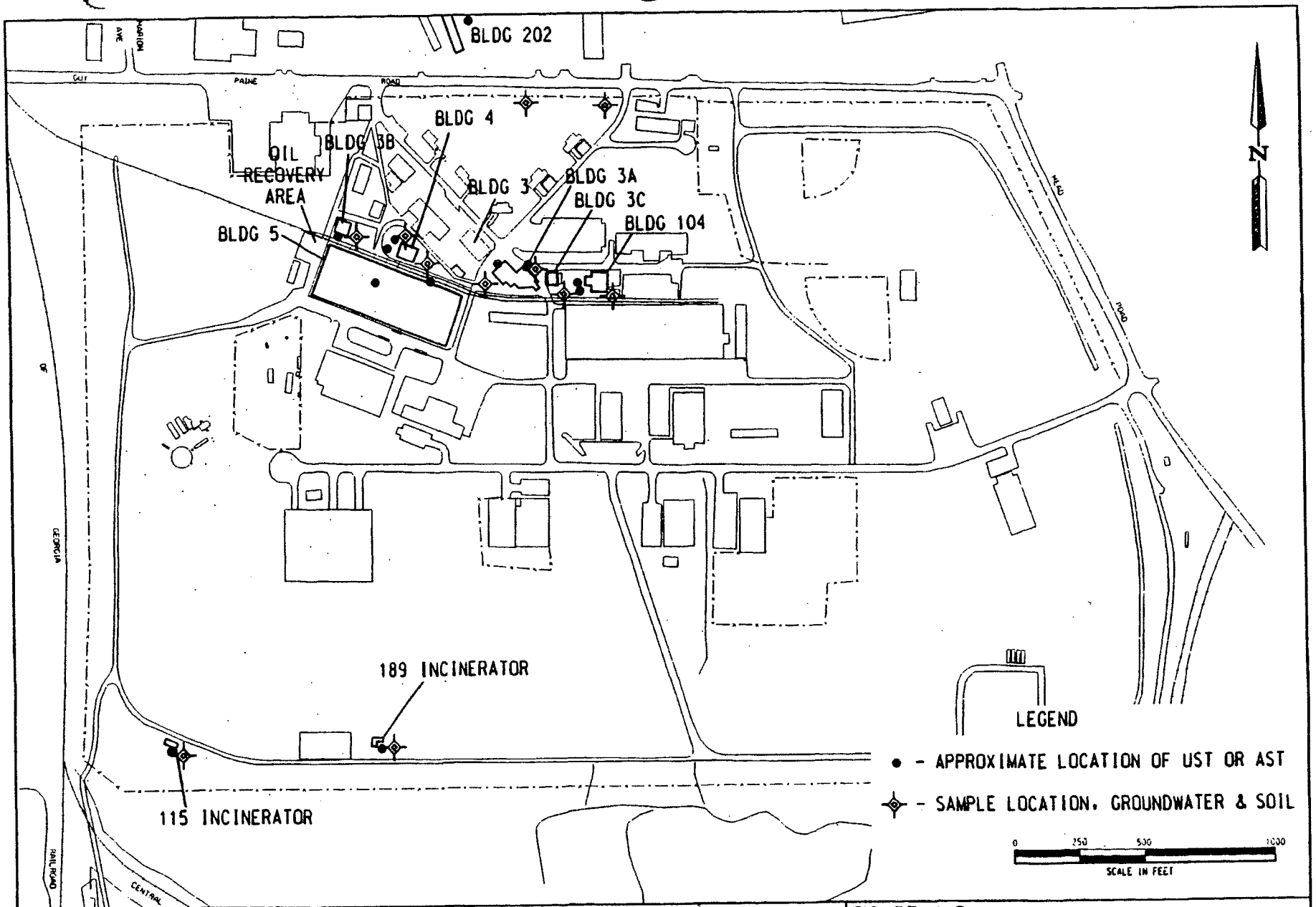
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-7
OFF SITE SOURCE PROPOSED SAMPLING
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA



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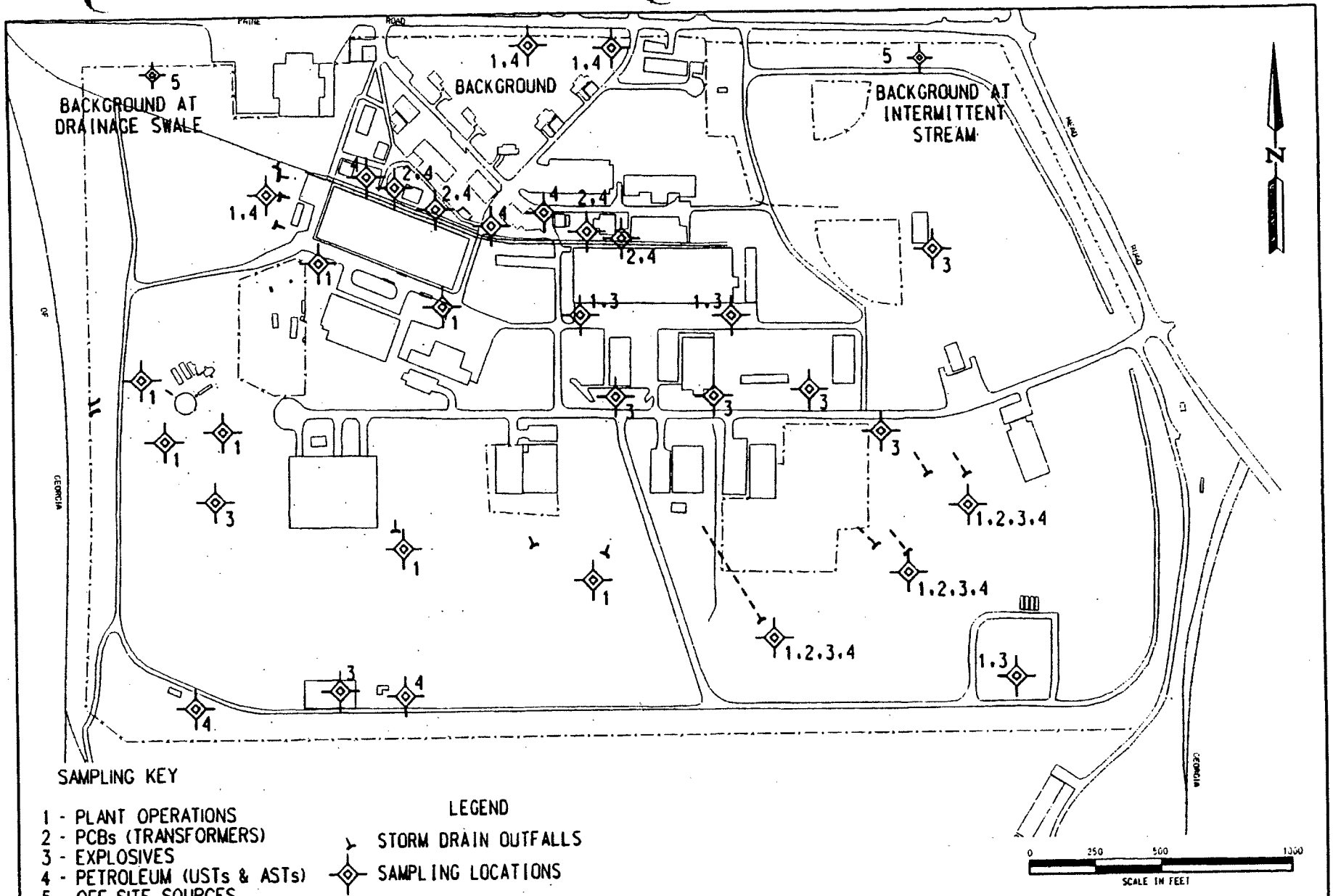
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-8
PROPOSED SAMPLING AREAS
USTs & ASTs
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

positively identifying the sources of contamination, and evaluating corrective actions. Approximate locations for all proposed sampling is shown on Figure 4-9.

4.5.2 Schedule of Activities

The time to complete the activities described in the previous section will depend on the amount of resources and equipment assigned to the tasks. The field sampling efforts described in the previous section could be completed in approximately two weeks assuming one direct push rig is mobilized to the site. The time required for laboratory results will vary, but all results should be available within 45 days. A review of the results and the preparation of a draft submittal to the regulatory agencies should be completed within 6 weeks of the return of the analytical results.



SAMPLING KEY

1 - PLANT OPERATIONS
2 - PCBs (TRANSFORMERS)
3 - EXPLOSIVES
4 - PETROLEUM (USTs & ASTs)
5 - OFF-SITE SOURCES

LEGEND

STORM DRAIN OUTFALLS
SAMPLING LOCATIONS

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RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 4-9
INDUSTRIAL PARK PROPOSED SAMPLING
FORMER MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

5.0 LANDFILL STUDY AREA

The second area identified for further study is the MNOP landfill. The landfill was used by the Department of Defense and the Navy during MNOP operations for waste disposal. Groundwater and soil samples collected in 1990 contained detectable levels of organics, metals, and explosive compounds.

5.1 DESCRIPTION

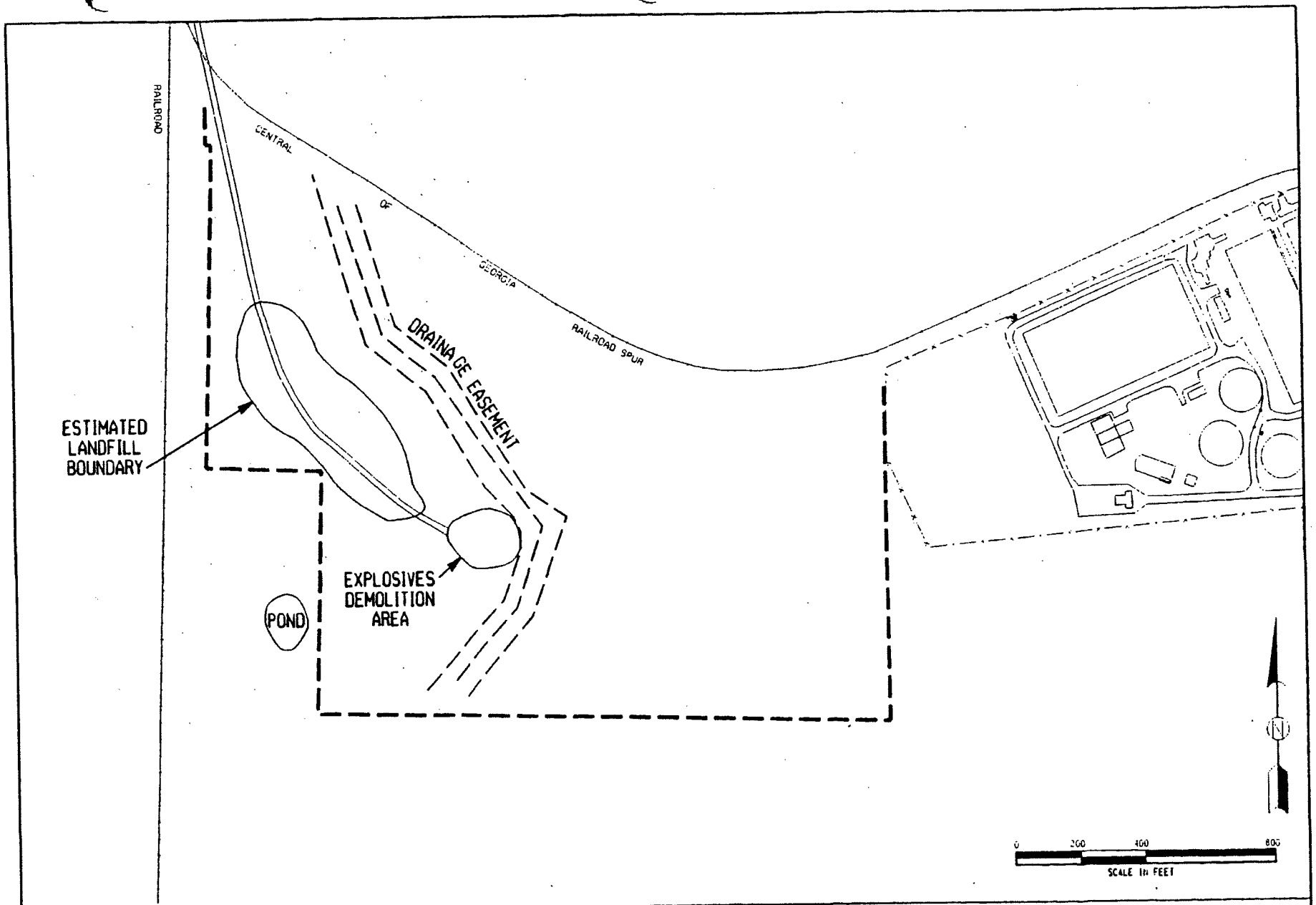
The MNOP landfill is located in the southwest corner of the former MNOP property (Figure 5-1). The topography in this study area slopes to the south from approximately 300 feet to 275 at Rocky Creek which is immediately south of the landfill. RUST E&I did not complete any borings in close proximity to the landfill. ESE reported the soils to be "generally sand with clay and silt" (ESE, 1990), which is consistent with RUST E&I findings in the industrial park study area.

The landfill was used by the Department of Defense and the Navy until 1965. Solid waste, explosives, and construction debris are known to have been disposed of in the landfill. An explosives demolition area is adjacent to the landfill on the east side. The only engineered components near the landfill on the former MNOP property are a fence and a bunker at the entrance to the demolition area. An area to the west of the landfill, not on the former MNOP property, was reported by ESE to contain approximately 500 unlabeled drums and a pond containing "reddish-orange water". About one dozen drums were seen in this general area during RUST E&I's site reconnaissance.

No details are known regarding the construction or depth of the landfill. ESE shows the landfill limits on their figures, but how those limits were determined is not documented (ESE, 1990). The maps included in this section were developed from aerial photographs interpreted by RUST E&I based on our understanding of the development and use of the landfill area. The well locations shown were placed by scaling the locations shown on the ESE drawings with relation to the property line. These maps should be considered approximate at this time.

5.2 WASTE CHARACTERIZATION

No specific records of waste disposition have been discovered in the research conducted for this project. The wastes generated by the MNOP have been characterized in the previous environmental assessments through speculation of derivatives from the production operations known to have been conducted. Since the beginning of production of ordnance at the plant by the Navy and Maxson, through the production of seat belts by Allied Chemical, many of the



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RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 5-1
LANDFILL STUDY AREA
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

basic operational wastes have remained the same. The primary exception to this is the generation of explosives constituents waste, which Allied Chemical would not be expected to have produced in their operations.

The inventory lists prepared by the Navy for the sale of assets to Maxson in 1965, were reviewed at the National Archives in East Point, Georgia. One of these lists labeled as the "Housekeeping Items", listed small equipment, parts, and supplies. A section of this list, consisting primarily of chemicals, indicated there were 35 drums (no size was specified; assumed 55-gallon drums) of trichlorethylene on-hand at the time of the property transfer to Maxson. Other chemicals, as well as paint, solvents, cleaners, and automotive parts were included on the list in primarily small quantities.

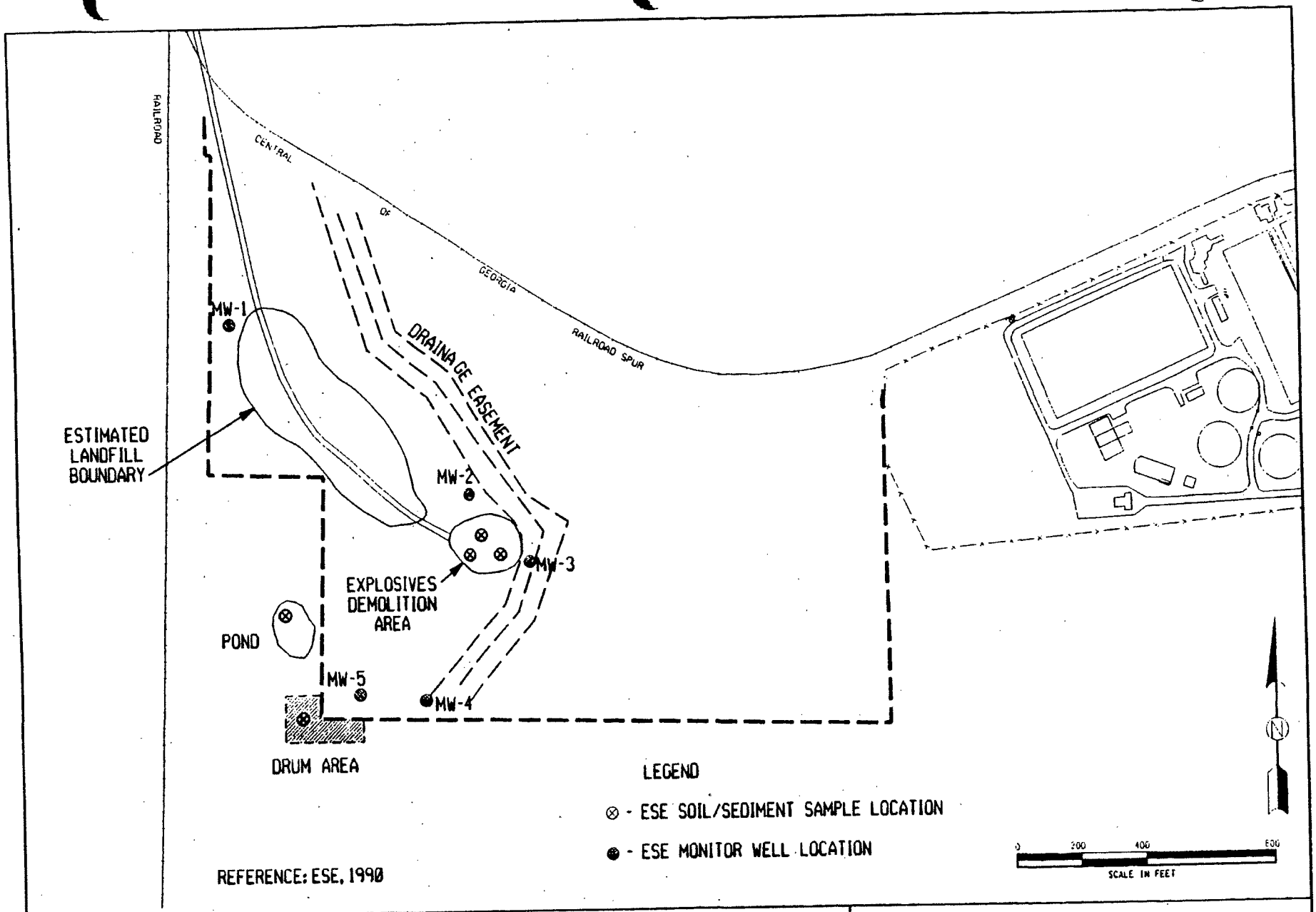
The by-product wastes of the MNOP would characteristically be considered to be of three types: domestic sewage, manufacturing wastes, and solid waste consisting of putrescible waste and construction debris. Some of the solid waste, explosives, and construction debris are known to have been disposed of in the landfill, and based on the common practices of the time, any of the facility by-products could have ended up in the landfill. The ESE report also noted the presence of a tank suspected to be contaminated with cyanide in the landfill.

5.2.1 Evidence of Releases

In 1989 and 1990, the Corps of Engineers and ESE collected and analyzed groundwater, soil, and sediment samples from the area around the landfill (Figure 5-2). Samples were collected upgradient and adjacent to the landfill, and on the adjacent property which contained drums and a pond. Organic and inorganic analytes were detected in each media.

Groundwater samples were collected from five monitor wells installed around the landfill, including one upgradient of the landfill (MW-1). Various metals were detected in almost all of the samples, but cyanide, arsenic, and selenium were detected in downgradient samples only. The explosives compounds 1,3-DNB and 2,4-DNT were detected downgradient of the landfill. PETN was detected in only the upgradient well. Trichloroethene and vinyl chloride were also detected downgradient of the landfill. Bis(2-ethylhexyl)phthalate was detected in every well and the equipment blank, and is not considered significant.

Soil samples were collected from the explosives demolition area on the east side of the landfill on two occasions. The only reported detections in these samples were for arsenic, barium, chromium and lead. No background soil data were provided.



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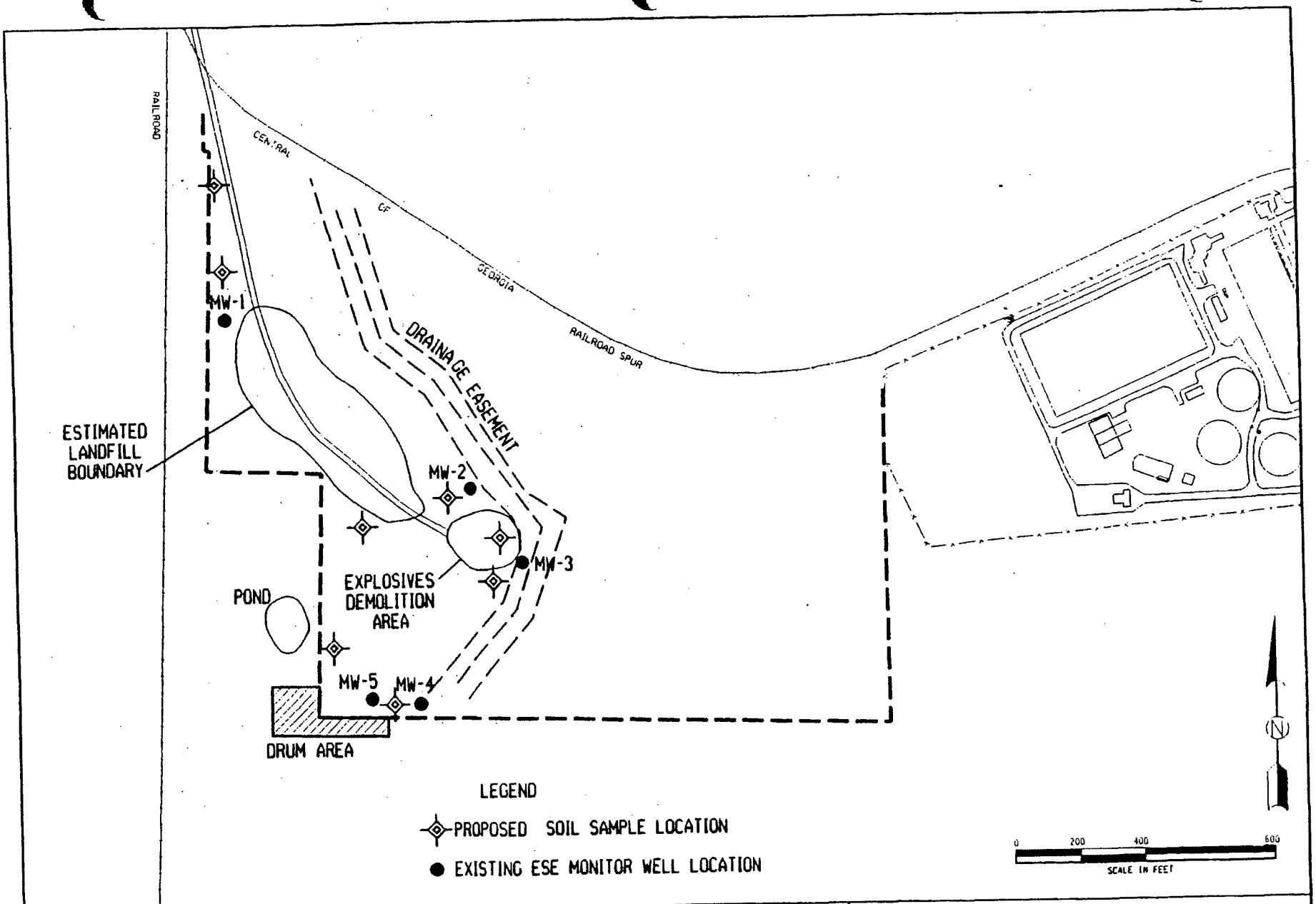
RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 5-2
ESE SAMPLE LOCATIONS
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

Table 5-1
Contaminants of Concern
Landfill Study Area
Former Macon Naval Ordnance Plant

Contaminant	CAS
1,3-Dinitrobenzene	99-65-0
2,4-Dinitrotoluene	121-14-2
Arsenic	7440-38-2
Barium	7440-39-3
Chromium	7440-47-3
Cyanide	57-12-5
Lead	7439-92-1
PAHs	various
PETN	115-77-5
Petroleum Hydrocarbons	N/A
Selenium	7782-49-2
Trichloroethene	79-01-6
Vinyl Chloride	75-01-4



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RUST ENVIRONMENT & INFRASTRUCTURE

FIGURE 5-3
PROPOSED SOIL SAMPLE LOCATIONS
MACON NAVAL ORDNANCE PLANT
MACON, GEORGIA

Table 5-2
HSRA Limits
Landfill Study Area
Former Macon Naval Ordnance Plant

Contaminant	CAS	Reporting Limit	Clean Up Levels Groundwater	Soil
1,3-Dinitrobenzene	99-65-0	1.05	0.001 A	1.05 C
2,4-Dinitrotoluene	121-14-2	0.66	0.00005 A	0.66 C
Arsenic	7440-38-2	41	0.05	20
Barium	7440-39-3	500	2	1000
Chromium	7440-47-3	1200	0.1	100
Cyanide	57-12-5	10	0.2	10 C
Lead	7439-92-1	300	0.015	75
PAHs	various	*	*	*
PETN	115-77-5	N/A	N/A	N/A
Petroleum Hydrocarbons	N/A	N/A	N/A	N/A
Selenium	7782-49-2	36	0.05	2
Trichloroethene	79-01-6	0.13	0.005	0.5
Vinyl Chloride	75-01-4	0.04	0.002	0.2 C

Notes:
All groundwater concentrations are in mg/L.
All soil concentrations are in mg/kg.
* = Specific values are established for the different PAH compounds.
A = Level is below the available detection limit.
C = Lower values may be required based on a risk assessment.

Two composite soil samples were collected from the adjacent property, one from the pond containing the reddish-orange water and one from the soils in the area of the drums. The sample from the pond contained a number of polycyclic aromatic hydrocarbons (PAHs) and petroleum hydrocarbons. The sample from the soil around the drums contained several metals, one PAH (benzo(g,h,i)perylene), nitrogen, and petroleum hydrocarbons.

The site reconnaissance conducted by RUST E&I revealed physical evidence for potential impacts originating from off-site sources. Sediment was evident as a grayish-white covering on submerged surfaces in the ditch located on southwest corner of the property. Water in this ditch crosses from the Armstrong Cork site to the MNOP site through a spillway and culvert. No odor was detected.

5.2.2 Contaminants of Concern

It is possible that any chemical used and/or manufactured by the plant could have been deposited in the landfill. However, based on the previous environmental investigations, a preliminary list of contaminants of concern has been developed. These contaminants are shown in Table 5-1.

This list is based on those constituents which have been detected in significant concentrations during ESE investigation. It should be noted that quality control and background data for these constituents are incomplete at this time. It is expected that some constituents will be removed and others added to this list after more complete investigative sampling results are obtained.

5.2.3 Waste Characteristics

The following waste characteristics were obtained from the Handbook of Toxic and Hazardous Chemicals and Carcinogens, Third Edition (Sitting, 1991) and the Handbook of Environmental Fate and Exposure Data (Howard, 1989). Hazardous substances, hazardous wastes, priority pollutants, and toxic chemicals are EPA designations for those contaminants. Those listed as carcinogens have been identified as such by the U.S. National Toxicology Program. The characteristics of each identified contaminant are summarized below.

1,3-Dinitrobenzene is a hazardous substance and hazardous waste constituent. Primary routes of entry are inhalation, ingestion, skin and eye contact, and percutaneous absorption of liquid. If exposed to prolonged fire or heat, 1,3-dinitrobenzene has a possibility of explosion due to spontaneous decomposition.

2,4-Dinitrotoluene is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary routes of entry are inhalation, ingestion, skin and eye contact, and

percutaneous absorption of liquid. 2,4-Dinitrotoluene is slightly mobile in soil, and may biodegrade in both aerobic and anaerobic soil zones. It will have a slight tendency to adsorb to sediments, and will not bioconcentrate in aquatic organisms.

Arsenic is listed as a carcinogen, hazardous substance, hazardous constituent waste, priority pollutant, and toxic chemical. It is insoluble in water. Primary routes of entry are inhalation, absorption, and ingestion.

Barium is a hazardous constituent waste and a toxic chemical. Primary routes of entry are inhalation, ingestion, and skin or eye contact.

Chromium is a carcinogen, hazardous substance, priority pollutant, and toxic chemical. Primary routes of entry are inhalation, ingestion, and skin and eye contact.

Cyanide is listed as an extremely hazardous substance, a hazardous waste, priority pollutant, and toxic chemical. Primary routes of entry include inhalation, skin absorption, ingestion, and eye and skin contact.

Lead is a hazardous substance, priority pollutant, and toxic chemical. Primary entry routes include ingestion, inhalation, and skin and eye contact.

Petroleum hydrocarbons is a generic name for aliphatic and nonhalogenated hydrocarbons. Petroleum hydrocarbons are not water soluble. Primary exposure routes may be skin absorption or inhalation.

Several different compounds are defined as polycyclic aromatic hydrocarbons. Toxicity data are available for benzo(a)pyrene and benzo(b)flouranthene. Both of these PAHs are carcinogens, hazardous substances, hazardous wastes, and priority pollutants. Primary entry routes are inhalation and ingestion, and skin absorption when contacted by soil or oil containing "high concentrations" (defined in the reference as those concentrations found "at a hazardous waste site").

No significant health effects are associated with exposure to PETN, even at abnormal use concentrations.

Selenium is a hazardous substance, priority pollutant, and toxic chemical. Primary entry routes include inhalation, percutaneous absorption of liquid, ingestion, and eye and skin contact.

Trichloroethene is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary entry routes include inhalation, percutaneous absorption of liquid, ingestion, and eye and skin contact. When released to soil, TCE will leach quickly to groundwater. While some biodegradation may occur, it will be slow. Adsorption to sediments and bioaccumulation are not significant.

Vinyl chloride is a carcinogen, hazardous substance, hazardous waste, priority pollutant, and toxic chemical. Primary entry routes include inhalation and ingestion. Vinyl chloride is very mobile in soil, and would be expected to leach rapidly into the groundwater. It would not be expected to bioaccumulate or adsorb to sediments.

5.3 HEALTH AND ENVIRONMENTAL ASSESSMENT

Based on the location and geology and the characteristics of the contaminants of concern for this study area, soil, groundwater, surface water, and sediments are all potential migration pathways. Any releases of contaminants to the environment by the landfill would probably have been to the soil, however these releases could have quickly leached into groundwater, which is very shallow in this area. The groundwater would quickly reach Rocky Creek, making its surface water and sediments potential secondary pathways.

For the contaminants listed, the most often cited routes of entry were ingestion, inhalation, and skin and eye contact. Therefore, the exposure pathways of concern would be those which provide direct contact with the soil, groundwater, sediments or surface. Consumption of fish from Rocky Creek would be a secondary exposure pathway for those contaminants which have a tendency to bioaccumulate.

Any exposure to surface soils in this study area would be from trespassers, as this area is no longer in active use. There are no known groundwater supply wells in this study area. The recreational use of Rocky Creek is not documented at this time. However, it would be expected to be very limited, if it exists at all, in the vicinity of the landfill.

5.4 REGULATORY REQUIREMENTS

The site has been placed on Georgia's Hazardous Site Inventory (HSI). This places it under the Hazardous Site Response Act (HSRA) regulations. It is also being considered for the National Priority List, which would place it under CERCLA regulations. For the purposes of this section, it is assumed that the HSRA rules are the applicable or relevant and appropriate requirements (ARARs) for the site.

The HSRA rules (Chapter 391-3-19) require that Georgia EPD be notified of any releases of regulated substances which:

- cause the concentration of the regulated substance in groundwater to exceed the naturally-occurring background concentration,
- cause the concentration of the regulated substance in soil to exceed the concentrations published in Appendix I of the rules, or
- are due to the discarding or abandonment of a regulated substance in containers, tanks, or vessels.

Of the contaminants of concern listed in Table 5-1, only PETN and petroleum hydrocarbons are not regulated substances under HSRA. Based on the concentrations detected in the ESE study, reportable soil and groundwater releases have already occurred in this study area. The soil concentrations reportable under HSRA for the identified contaminants of concern are shown in Table 5-2.

Action levels under HSRA are not determined by specific concentrations, but are calculated using the Reportable Quantity Screening Method (RQSM). The RQSM is calculated for each regulated substance which has had a reportable release in either soil or groundwater. A RQSM score of 10 for the groundwater pathway or 20 for the on-site (soil) pathway would place the site on the HSI.

Once a site is on the HSI, the responsible party must issue a compliance status report which documents the extent and source of the contamination, any human and environmental receptors, previous or proposed corrective actions, and the site's compliance with the risk reduction standards defined in the HSRA rules. Compliance with the Type 1, 2, 3, or 4 risk reduction standards qualifies the site for removal from the HSI.

Clean up levels under HSRA rules are dependent on which risk reduction standard is met. The most likely standard for this study area would be Type 3, which is based on standard exposure assumptions and defined risk levels for non-residential use properties. Clean up levels defined in the rule appendices are listed in Table 5-2.

5.5 RECOMMENDATIONS

5.5.1 Field Investigation Plan

This section is intended to provide an overview of what sampling is needed in this study area and the rationale for it. At this time, the sampling schemes discussed in this report should be considered minimum sampling requirements. As a separate submittal for this project, RUST E&I is preparing a detailed scope of work for the sampling to be performed in this study area. This scope of work may include additional sampling requirements.

Soil, groundwater, surface water and sediments should be sampled and analyzed in this study area to establish the presence and concentration of environmental contamination caused by the landfill in these media. All samples should be analyzed for Target Compound List (TCL) volatile and semi-volatile organics, Target Analyte List (TAL) metals, and the explosive compounds 1,3-DNB, and 2,4-DNT. Additional soil samples should also be collected and analyzed for petroleum hydrocarbons. These analyses include all of the contaminants of concern listed in Table 5-1 except PETN.

The existing monitor well locations and depths around the landfill are appropriate for groundwater sampling based on RUST E&I's interpretation of the ESE drawings and aerial photos. However, the wells should be surveyed again to establish their actual locations. During RUST E&I's site reconnaissance, the wells appeared to be in good condition. Assuming they have remained intact below the ground surface, they can be used for the groundwater sampling following appropriate purging techniques. Water level measurements should also be taken from the wells to determine the groundwater flow direction.

Proposed soil sampling locations are shown in Figure 5-3. These locations will provide data on background and downgradient concentrations, as well as, data on possible impacts that may have migrated from the off-site area containing the drums and the pond. Soil samples should be collected at regular intervals between the ground surface and the water table. Those samples which show the highest organic concentrations based on field readings should be submitted for analysis.

Surface water and sediment samples should be collected from Rocky Creek at a point upgradient, and at the closest point downgradient, from the landfill. Surface water and sediment samples should also be collected from the drainage ditch which crosses into the MNOP property just north of the landfill. Sediment samples should be collected from the first 12 inches of sediment.

The results of these sampling events will be sufficient to establish the presence of the contamination in this study area. These results should be enough to determine the regulatory status of this study area, and what, if any, additional actions are necessary. Possible actions could include determining the lateral and vertical extent of contamination, more positively identifying the sources of contamination, and evaluating corrective actions.

5.5.2 Schedule of Activities

The time to complete the activities described in the previous section will depend on the amount of resources and equipment assigned to the tasks. The sampling events described in the previous section could be completed in approximately two weeks. The time required for laboratory results will vary, but all results should be available within 45 days. A review of the results and the preparation of a draft submittal to the regulatory agencies should be completed within 6 weeks of the return of the analytical results.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

- Based on information obtained through the historical data search and interviews with former employees, the operations, methods, and materials used by the Macon Naval Ordnance Plant could have resulted in several sources of groundwater and soil contamination. These sources include the storm drain outfalls, the former sewage treatment plant, the metal plating facilities, electric transformer buildings, areas of explosives handling and storage, above ground and underground storage tanks, and the plant's landfill.

- Previous reports indicate that Maxson and Allied basically continued with the methods, materials, and operations of the MNOP in their subsequent ownership of the site, except that Allied did not use explosive materials. Therefore, it is possible that environmental contamination occurred during their ownership from the same sources.

- A review of regulatory files for the current occupants of the industrial park did not reveal any environmental regulatory actions or concerns. Activities being conducted at the site at this time include manufacturing, machining, fabrication, distribution, storage, office and warehouse operations. While some of these activities include the use and disposal of chemicals, the specific types and quantities are not known. Because of this, and the lack of any regulatory information, it is not possible to speculate on the potential environmental impacts of the current occupants.

- There are physical indications that environmental contamination may come onto the site from off-site sources. Areas of primary concern are the drainage ditches at the northeast and southwest corners and the area just west of the MNOP landfill identified by ESE as having drums and a pond. Nearby sites with existing regulatory actions include the General Chemical-Macon Works site, the Armstrong Cork site, and the Riverwood International site. However, the Riverwood site is downgradient from the MNOP site and is unlikely to have any environmental impacts on it.

- The existing environmental data for the site is of very limited use. The data obtained by ESE, Westinghouse, and Beaver Engineering show the presence of contamination in small areas of soil and groundwater at the site. The soil types

and groundwater flow direction information obtained by ESE generally agree with that found by RUST E&I. However, no quality control or background information is provided by Westinghouse and Beaver Engineering, and very little is provided in the ESE report. Although the ESE investigation involved two of the possible sources identified by RUST E&I (the landfill and the oil recovery area), none of the other possible sources of contamination have been studied.

- A hydrogeologic model of the site was developed for the surficial aquifer. The model shows that the surficial aquifer is unconfined. Groundwater at the site flows to the south-southeast, with an average calculated flow velocity of 44 feet per year. The depth to groundwater at the site ranges from 4 to 48 feet.

- The site is currently listed as a Class II site on the Georgia Hazardous Site Inventory. The rules of the Hazardous Site Response Act establish the reporting, action, and clean up levels for the site.

- Because the constituents, concentrations, and extent of any environmental contamination at the site have not been established and cannot be estimated at this time, remediation activities cannot be determined without further investigation.

6.2 RECOMMENDATIONS

- Two areas of the former MNOP property have been identified for further study - the industrial park area and the landfill.

- Soil and groundwater samples should be collected near the identified on-site source areas in the industrial park study area. These sources include the storm drain outfalls, the former sewage treatment plant, the metal plating facilities, electric transformer buildings, areas of explosives handling and storage, and the above ground and underground storage tanks.

- Surface water and sediment samples should be collected from the drainage ditch which enters the site in the northeast corner. These samples will determine if contamination from off-site sources is impacting the site.

- Groundwater, soil, surface water and sediment samples should be collected in the area of the landfill. These samples will establish the presence and constituents of any contamination due to the landfill, the explosives demolition area, the off-site drum and pond area, and drainage ditch.

- The sampling activities described in this report provide an overview of what sampling is needed in this study area and the rationale for it. At this time, these should be considered minimum sampling requirements. The detailed scope of work which is being prepared as part of this project will specify all sampling requirements in detail and may include additional sampling requirements.

- The sample locations and subsequent analysis should be evaluated to determine if contamination exists near the likely source areas and to determine the regulatory status of the study areas and any additional actions.

- If contamination exists which requires further action, additional hydrogeologic information will need to be gathered. This will probably include the installation of piezometers and monitor wells, some of which will need to be nested with deep wells.

REFERENCES

American Society for Testing and Materials, "Standard Method for Penetration Test and Split-Barrel Sampling of Soils, ASTM Designation: D 1586-84."

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Georgia EPD, 1992, "Preliminary Assessment, Former Macon Naval Ordnance Plant A.K.A. Allied Chemical Corporation GAD 003302676", Atlanta, Georgia.

Howard, P.H., 1990, "Handbook of Environmental Fate and Exposure Data", Lewis Publishers, Chelsea, Michigan.

LeGrand, H.E., 1962, "Geology and Ground-Water Resources of the Macon Area, Georgia," U.S.G.S. and Georgia Department of Mines, Mining, and Geology, Atlanta, Bulletin No. 72.

National Institute for Occupational Safety and Health (NIOSH), 1990, "NIOSH Pocket Guide to Chemical Hazards", DHHS Publication Number 90-117.

Sittig, M., 1991, "Handbook of Toxic and Hazardous Chemicals and Carcinogens", Noyes Publications, Park Ridge, New Jersey.

U.S. Army Corps of Engineers, Savannah, 1989, "Inventory Project Report for U.S. Navy Ordnance Plant, Macon, Bibb County, Georgia, Project No. I04GA081300."

U.S. Geological Survey, 1985, Macon West Quad., Georgia-Bibb County, 7.5 minute topo series.

Westinghouse Environmental & Geotechnical Services, Inc., 1991 "Modified Phase I Preliminary Environmental Evaluation, Allied Industrial Park, ± 28-Acre Site, Macon, Georgia" Macon, Georgia.

The facility is located in the Atlantic Coastal Plain Physiographic Province and Atlantic and Gulf Coastal Plain hydrogeologic setting just south of the Fall Line area, which separates the coastal plain sediments from the Piedmont crystalline rocks (Refs. 5; 6, pp. 270, 271; 7, p. 3, Figure 1). The Piedmont rocks are typified by a complex of metamorphic and igneous rocks with a thin veneer of residual soil and weathered rock. The Cretaceous coastal plain deposits form a thin layer of unconsolidated sediments north of the facility and increase in thickness to the south in the direction of the dip of the sediments (Refs. 8, p. 11). The net annual precipitation for the Macon area is approximately 3 inches (Ref. 9). The maximum 1-year, 24-hour rainfall amount is approximately 3.3 inches (Ref. 10). The facility is located at a longitude of 83°38'07" west and a latitude of 32°46'37" north (Ref. 5).

Groundwater is found in this area under water-table conditions as a shallow surficial aquifer within three different hydrologic environments (Ref. 11, p. 20). Quaternary alluvial deposits of unsorted gravel and sandy clay along the Ocmulgee River and its streams comprise one type of unconfined surficial aquifer (Ref. 11, p. 33). These deposits are usually less than 40 feet thick (Ref. 11, p. 36). The outcropping Tuscaloosa Formation of Cretaceous sediments form a second type of water-table aquifer where the alluvium is not situated above it. The aquifer consists of fine-to-coarse grain sands with lenticular beds of clay, though the clay does not act as a confining layer between the alluvial aquifer and this Cretaceous aquifer. The Tuscaloosa beds dip at approximately 30 feet per mile to the southeast (Ref. 11, pp. 23, 36). Three wells were drilled into the Cretaceous sediments in the Macon area and varied in depth between 60 to 114 feet below land surface (bls) (Ref. 11, p. 39, Table 3). The water yields from the Cretaceous aquifer are 36,000 to 468,000 gpd (Ref. 11, p. 39, Table 3). The water level varies between 21 and 35 feet bls. The depth to this water table varies with the frequency, duration, and intensity of the precipitation, as well as the topographic elevation and position (Ref. 8, p. 11). The hydraulic conductivity for sediments similar to these ranges between 1.0 x 10-3 to 1.0 x 10-1 cm/sec (Ref. 12, p. 29). Groundwater is obtained from the Piedmont granitic bedrock in the overlying regolith, as well as from joints, fractures, and other secondary openings of the crystalline rock (Ref. 11, p. 12). Amounts are generally low, with the average expected yield around 28,800 gpd (Ref. 8, p. 21).

The Macon-Bibb County Water Department municipal water system serves the area near the facility (Ref. 13). The water system is supplied by surface water from the Ocmulgee River, with the intake located 9 miles upstream from the point Tobesofkee Creek enters the Ocmulgee River (Ref. 5). The majority of residents within a 3-mile radius of the facility are served by the Macon-Bibb County Water Department (Ref. 13).

Residents not served by a municipal system, obtain water from private wells. The closest private well is estimated to be 13,000 feet southwest of the facility (Refs. 5, 14). A house count on topograhic maps of the area indicates that 139 homes within a 3-mile radius of the facility are not served by a municipal system. Additionally, 137 homes located between 3 and 4 miles from the facility are also not served by a municipal system (Refs. 3, 5).

Surface water drainage at the facility flows east 0.5 mile to an unnamed lowland which continues south 3.5 miles until it merges with Tobesofkee Creek. Approximately 2.5 miles downstream, the creek flows into the Ocumlgee River (Ref. 5). The remainder of the 15-mile migration pathway is along the Ocmulgee River (Ref. 5). No municipal intakes are located within 15-miles downstream of Allied (Ref. 15). Sport fishing does occur on the Ocmulgee River (Ref. 16).

NUS CORPORATION
127 LAKESIDE PARKWAY
SUITE 614
TUCKER, GEORGIA 30084
404-938-7710

C-586-8-0-29

August 23, 1990

Date: 8-29-90
Site Disposition: NPL/RP
EPA Project Manager:

Mr. A.R. Hanke
Waste Programs Branch
Waste Management Division
Environmental Protection Agency
345 Courtland Street, N. E.
Atlanta, Georgia 30365

Subject: Screening Site Inspection, Phase I
Allied Chemical Corporation
Macon, Bibb County, Georgia
GAD039136080
TDD No. F4-9002-98

Dear Mr. Hanke:

FIT 4 conducted a Phase I Screening Site Inspection at Allied Chemical Corporation in Macon, Bibb County, Georgia. This assessment included a review of EPA and state file material, completion of a target survey, and an offsite reconnaissance of the facility and surrounding area.

The Allied Chemical Corporation facility is a manufacturing plant located at 4652 Mead Road in southeast Macon (Ref. 1). Allied Chemical merged with General Chemical 3 years ago and is now General Chemical (Refs. 2, 3). The current owner of the property is One Newco Inc. (Ref. 3). File material does not indicate when Allied Chemical was put into operation. The facility property is approximately 22 acres in size, has one manufacturing building, and seven large holding tanks. The facility also has two basins that are used for sludge disposal (Ref. 1). The facility produces alum, which is used in water treatment as a pH adjuster and flocculant (Ref. 2). Land in the vicinity of the facility is used for both industrial and residential purposes with numerous strip mines located to the northeast of the facility (Refs. 3, 4). The nearest residence is located adjacent to the facility beside the northwest corner of the property (Ref. 3).

The facility produces alum, which is used in water treatment as a pH adjuster and flocculant (Ref. 2). Silica sludge, the waste product of the alum manufacturing, is pumped into a 1-acre primary settling basin and then a 1.5-acre evaporation basin. Sulfuric acid and bauxite are used to produce the alum, which causes the sludge to have a pH between 3.5 and 5.0. Approximately 16,000 tons of sludge were deposited prior to 1979, covered with 1 foot of clean earth, and seeded to help minimize erosion. Allied Chemical was granted a solid waste handling permit by the Georgia Environmental Protection Division in September 1980 (Ref. 1). The facility was granted conditionally exempt generator status in August 1980 (Ref. 4).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

cc: Allied Chem. File
Tom Yocum

JAN 06 1994

4WD-WPB

Mr. William P. Thompson
Macon/Bibb Industrial Authority
305 Coliseum Drive
P.O. Box 207
Macon, Georgia 31202

SUBJ: Allied Chemical Corporation (GAD003302676) and
Allied/Former Macon Naval Ordnance Plant (GAD039136080)

Dear Mr. Thompson:

The Allied Chemical Corporation is located at 600 Guy Paine Road in Macon, Bibb County, Georgia. The property was operated as a U.S. Naval Ordnance plant during the period 1941-1965. Allied Chemical Corporation purchased the property in 1973 and manufactured seat belt components until 1981.

The property is divided into two separate Comprehensive Environmental Response Compensation and Liability Act (CERCLA) sites by a railroad right-of-way owned by the Central of Georgia Railroad (Figure 1). The site north of the railroad right-of-way is the Allied Chemical Corporation site (GAD039136080). The site was discovered in 1979 and consists of the major areas of operation for the Allied Chemical Corporation. A recommendation of "No Further Remedial Action Planned" (NFRAP) was made for the Allied Chemical Corporation site following a 1990 screening site inspection.

The term "NFRAP" means that to the best of the EPA's knowledge, Superfund has completed its assessment at a site, and has determined that no further steps to list the site on the NPL will be taken unless information indicating that the decision was not appropriate or other considerations make a recommendation for listing appropriate at a later time. A "NFRAP" decision does not necessarily mean that there is no hazard associated with a given site; it means only that based upon available information, the location is not judged to be a potential NPL site.

The Allied/Former Macon Naval Ordnance site (GAD003302676) is located south of the Central of Georgia Railroad tracks (Figure 2). The site is a 15-acre landfill which is alleged to have been used for the improper disposal of wastes and ordnance. Analysis of groundwater samples collected from monitoring wells showed elevated levels of lead, arsenic, cyanide, TCA and assorted polyaromatic hydrocarbons (PAHs).

During an offsite reconnaissance, the facility was completely fenced and workers were noticed on site. No stressed vegetation was noted (Ref. 3). The population within 1 mile of the facility is 1,764; 17,995 people live within 3 miles; and 44,113 people live within 4 miles of the facility (Ref. 17).

Although the ranges of some endangered or threatened species include the state of Georgia, there are no critical habitats designated in Bibb County (Ref. 18). Freshwater wetland areas are located to the east of the facility about 5,000 feet (Ref. 5). These wetlands consist of reclaimed strip mine land and flood plains of the Ocmulgee River and its tributaries.

Based on the results of this evaluation, FIT 4 recommends that no further remedial action be planned for Allied Chemical Corporation. If you have any questions or comments about this assessment, please contact me at NUS Corporation.

Very truly yours,

G. Tim Phillips
Project Manager

GTP/jec

Enclosures

cc: Mario Villamarzo

Approved:

G. Tim Phillips

Professional Geologist

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

MEMORANDUM

DATE: January 24, 1994

SUBJECT: Allied/Former Macon Naval Ordnance (GAD003302676)

FROM: John A. McKeown
Georgia Project ~~Officer~~
South Unit/WMD

TO: Angela Stevens
Planning & Information Management Unit

The EPA Site Assessment Section met with Mr. Tom Moody of the Macon Bibb Industrial Authority on January 19, 1994. During the meeting it was determined that the CERCLA site presently listed as the Allied/Former Macon Naval Ordnance Plant (GAD003302676) located in Macon, Bibb County, Georgia is actually two separate sites.

Hence, the name of the site needs to be changed to the Allied Industrial Park (GAD003302676) and a new site was discovered on January 21, 1994. The name of the new site is the Former Macon Naval Ordnance Landfill and an EPA ID Number has yet to be assigned.

This site is a formerly used defense (FUD) site and is scheduled to undergo further remedial work through the U.S. Army Corps of Engineers. EPA will wait until this study is completed and then incorporate information obtained through the Corps of Engineers' study into its Site Inspection at the site.

If you have any questions concerning this matter, please contact John McKeown of my staff at (404) 347-5065.

Sincerely,

Joseph R. Franzmathes
Director
Waste Management Division

Enclosures (2)
1. Corps of Engineers Site Location Map
2. Corps of Engineers Site Layout Map

cc: Richard Ray

Doc. Control
FILE: 89353-0002 IN

MEMORANDUM

JOB# 89353.000 FMNOP

DATE 6/29/94

DATE: *June 29, 1994*

TO: *Theresa Talty, Glenn Boylan*

FROM: *Brian Anders* BA

SUBJECT: *EPA Files Reviewed*

Today, I reviewed three SUPERFUND files at the EPA Region IV offices. These files were as follows:

1. *ALLIED INDUSTRIAL PARK*
   GAD003302676

2. *ALLIED CHEMICAL CORP.*
   GAD039136080

3. *FORMER MACON NAVAL ORDNANCE LANDFILL*
   GA0000102178

Historically these three separate properties were often interconnected and therefore some documents reviewed were found to overlap in various files. Only one copy of a document was obtained for our files.

Notes: The Allied Industrial Park refers to all property north of the GA RR within the former MNOP property boundary. This property is "on hold" until the Corps' Study is completed.

The Allied Chemical Corp. refers to the property east of the former MNOP, currently owned by One Newco Inc., formerly General Chemical. Approximately 22 acres; one manufacturing building; seven holding tanks (includes sulfuric acid and bauxite). This site is currently a "No Further Remedial Action Planned" (NFRAP) site.

The Former Macon Naval Ordnance Landfill received an EPA ID # in 1994. This property is also "on hold" until the Corps' Study is completed.

No RCRA files were found by the EPA researchers during my visit. They did tell me that John McKeown is the EPA/SUPERFUND Project Manager @ 347-3555 x-6166.

G:\WP51\BPA\MNOP-EPA.MEM

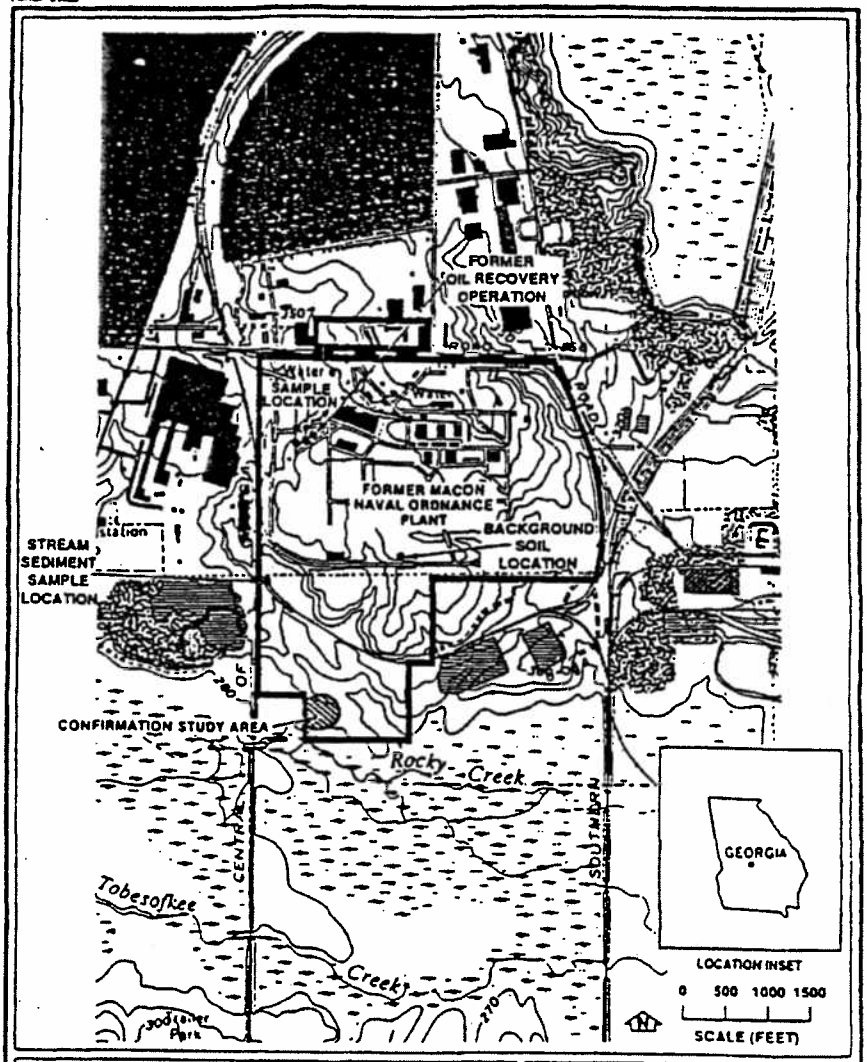


Figure 3-2
ADDITIONAL SAMPLE LOCATIONS INVESTIGATED DURING SECOND FIELD EFFORT

SOURCES: USGS, 1983; ESE, 1988.

CORPS OF ENGINEERS
MOBILE DISTRICT

Former Macon Naval Ordnance Plant

U.S. EPA SUPERFUND PROGRAM

** C E R C L I S **

LIST-8: SITE/EVENT LISTING

SELECTION: ** SPECIAL **
SEQUENCE: STATE, CNTY CODE, SITE NAME
EVENTS: ALL

RUN DATE: 12/18/9
RUN TIME: 10:37:5
VERSION: 1

EPA ID NO.	SITE NAME / STREET / CITY / COUNTY CODE AND NAME	STATE	ZIP CONG DIST.	NFA. FLAG	OPRBLE UNIT	EVENT TYPE	ACTUAL START DATE	ACTUAL COMPL DATE	CURRENT EVENT LEAD
GAD981020696	NASHVILLE OLD CITY LANDFILL S. DEAL ST., S OF CLARK DR JCT NASHVILLE 019 BERRIEN	GA	31639		00	DS1 PA1		10/22/85 12/30/85	EPA (FUND) STATE(FUNC
GAD981023042	NASHVILLE PESTICIDE DISPOSAL SITE JCT SOUTH DEAL ST & CLARK DR. NASHVILLE 019 BERRIEN	GA	31639		00	RV1 DS1 PA1 SI1 AR1	11/18/85 10/20/88	11/23/85 09/26/85 12/31/85 01/26/89 	EPA (FUND) EPA (FUND) STATE(FUND STATE(FUND EPA (FUND)
GAD981020811	PARTAIN PESTICIDE BURIAL PIT SOUTH OF GA HWY 168 NASHVILLE 019 BERRIEN	GA	31639		00	DS1 PA1 SI1		11/13/85 05/20/86 09/20/88	EPA (FUND) STATE(FUND STATE(FUNC
GAD039136080	ALLIED CHEMICAL CORP 4652 MEAD RD BOX 472 MACON 021 BIBB	GA	31202		00	DS1 PA1		11/01/79 12/01/79	EPA (FUND) EPA (FUND)
GAD003302676	ALLIED CHEMICAL CORPORATION 600 GUY PAINE ROAD MACON 021 BIBB	GA	31206		00	DS1		09/25/89	OTHER
GAD057281156	BETZ LABORATORIES INC 7525 NE INDUSTRIAL BLVD MACON 021 BIBB	GA	31297		00	DS1 PA1		08/01/80 09/17/85	EPA (FUND) STATE(FUNC
GAD000615914	BOEING MACHINE PRODUCTS 7898 41ST HWY S MACON 021 BIBB	GA	31201	NFA	00	DS1 PA1		08/01/80 03/01/84	OTHER STATE(FUN
GAD984279224	ELEVENTH ST. LANDFILL 11TH & WALKER SWAMP ROAD MACON 021 BIBB	GA	31201	NFA	00	DS1 PA1	 09/14/90	08/02/89 09/28/90	STATE ONL EPA (FUND

Not part of FMNOP

Former Macon Naval Ord. Plant

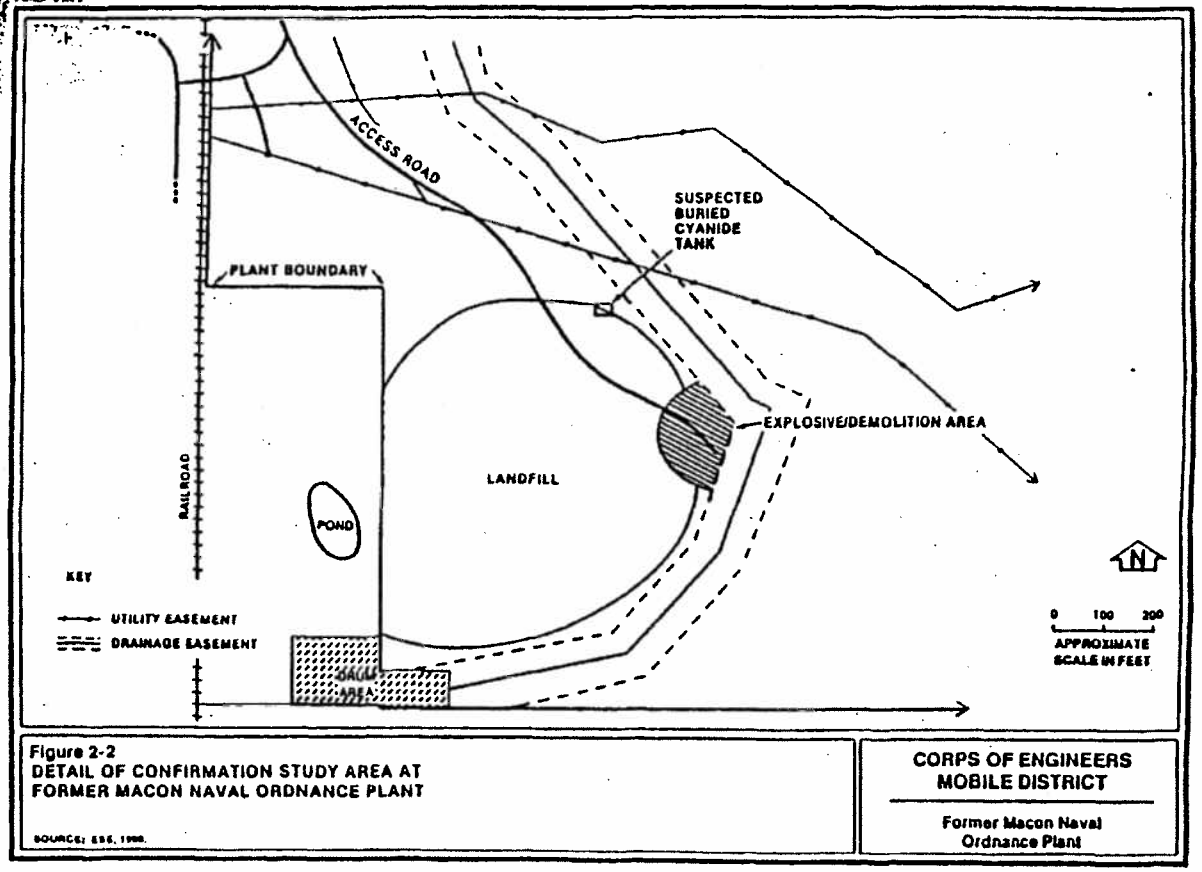
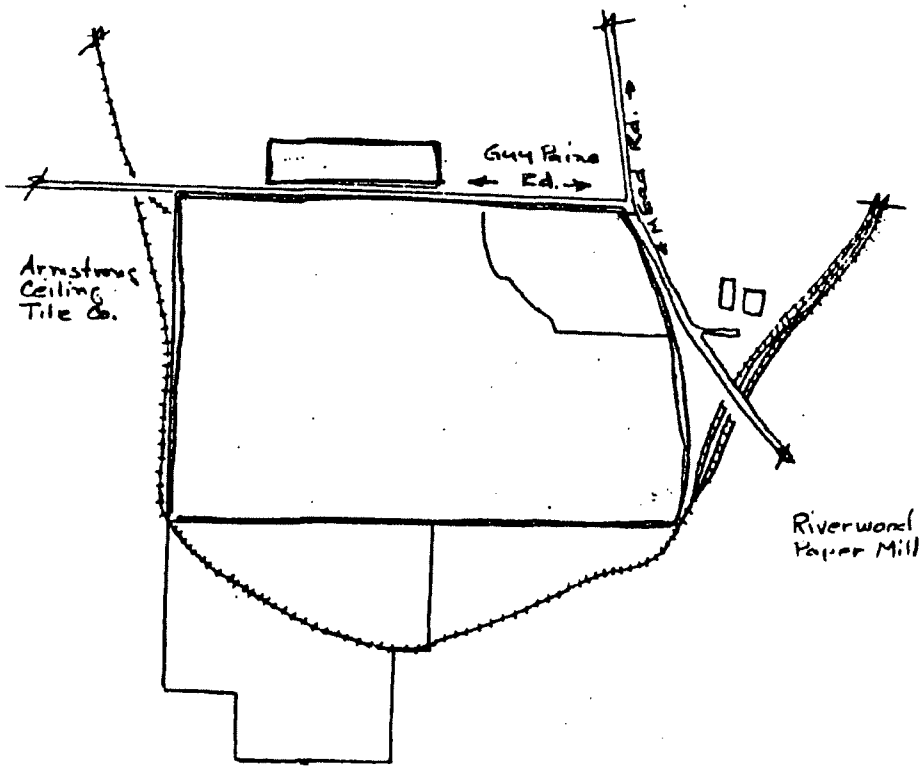


Figure 2-2
DETAIL OF CONFIRMATION STUDY AREA AT
FORMER MACON NAVAL ORDNANCE PLANT

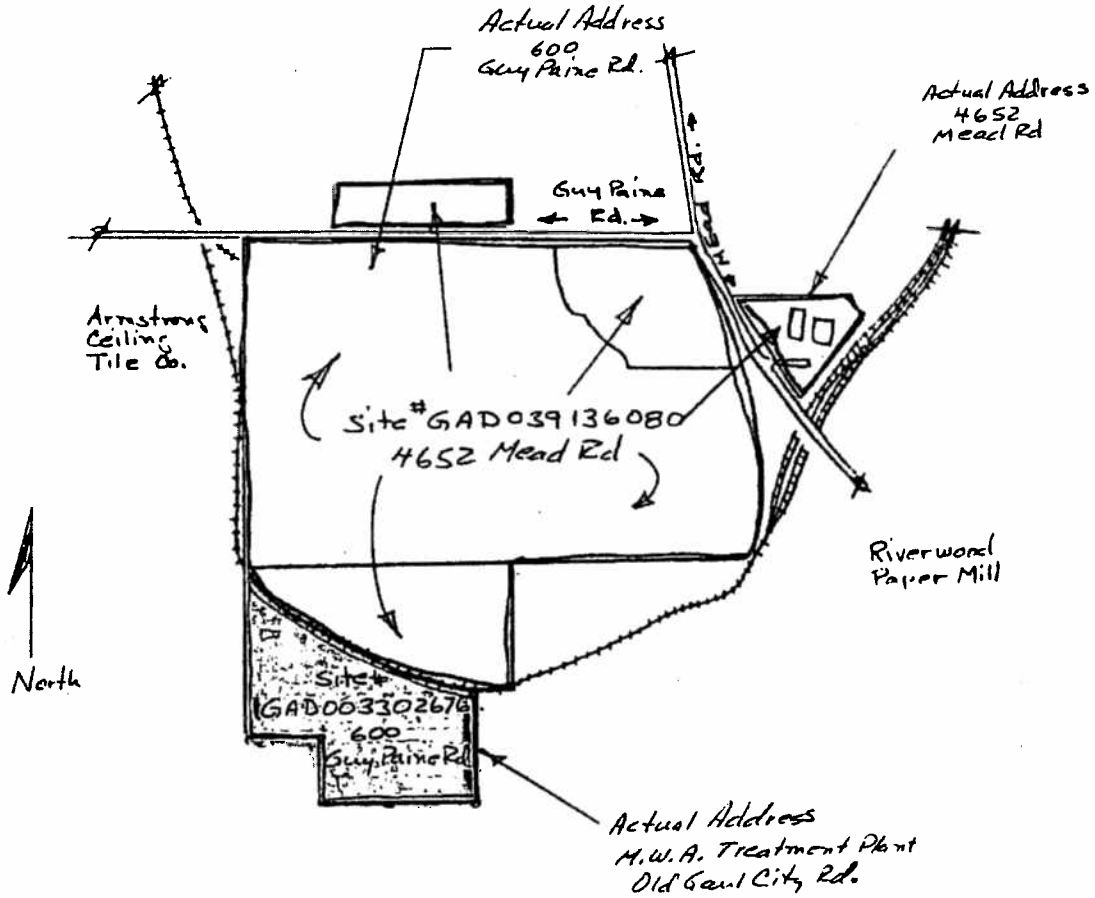
SOURCE: ESE, 1988.

CORPS OF ENGINEERS
MOBILE DISTRICT

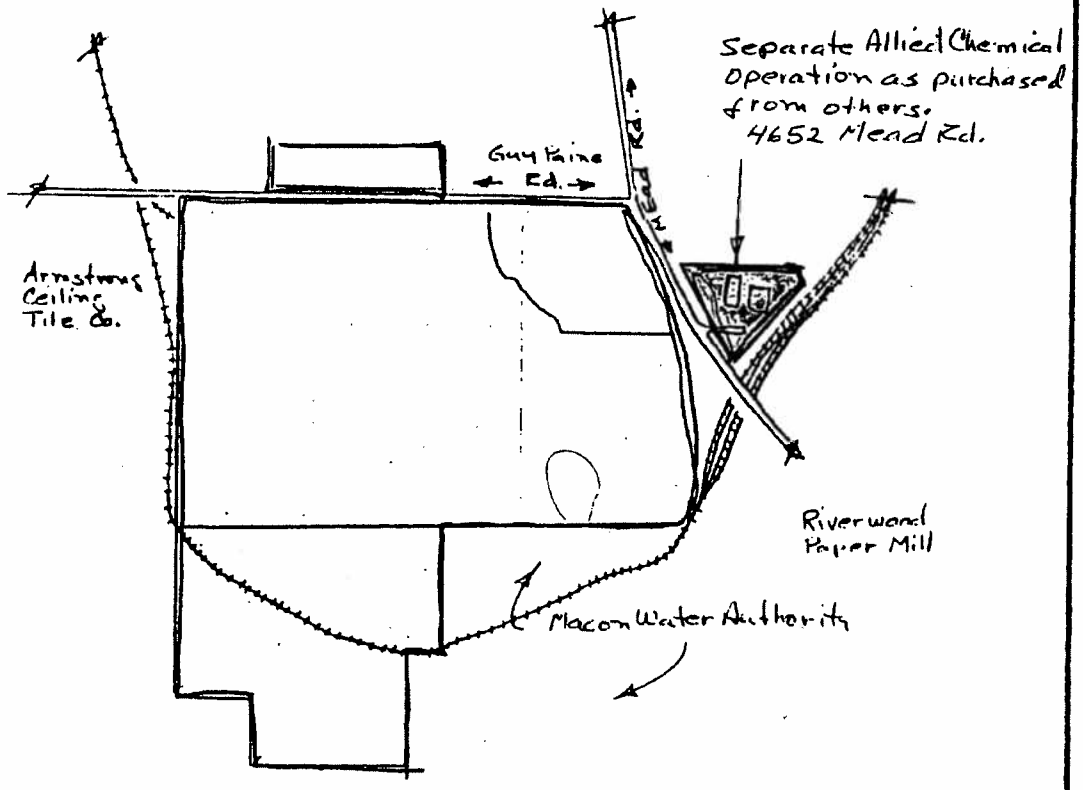
Former Macon Naval
Ordnance Plant



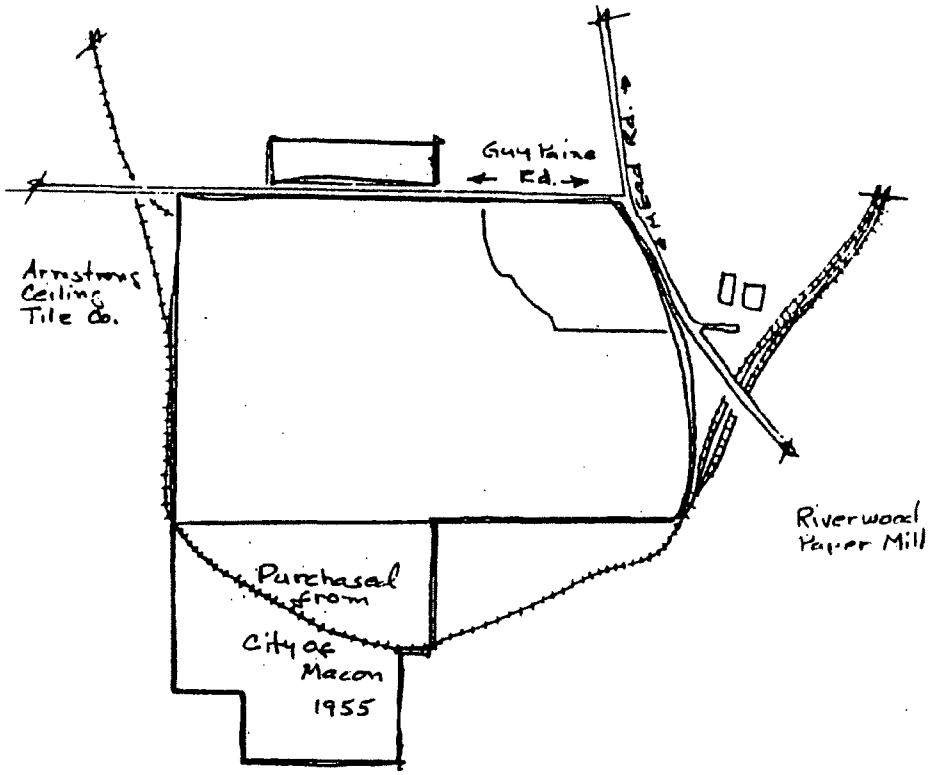
U. S. Naval Ordnance Plant
Original Boundries
1940 – 1955



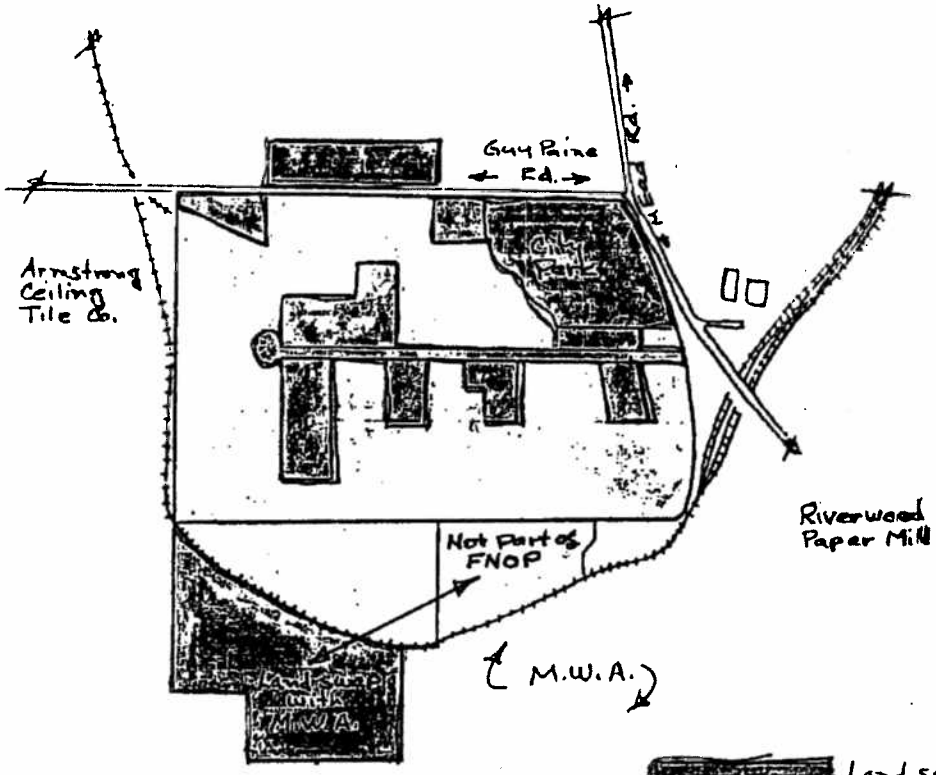
Site Identification per
Letter of 1-6-94



Allied Chemical Corp.
As Purchased from
Maxon Electronics
1973

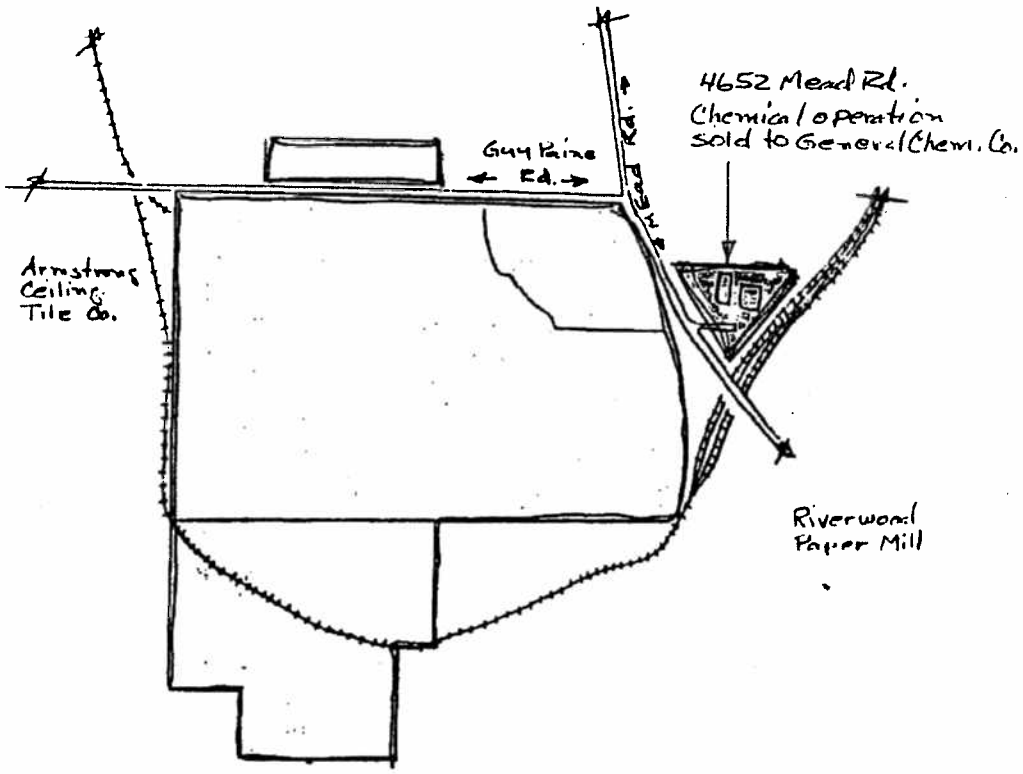


U.S. Naval Ordnance Plant
As sold to Maxon Electronics
1965

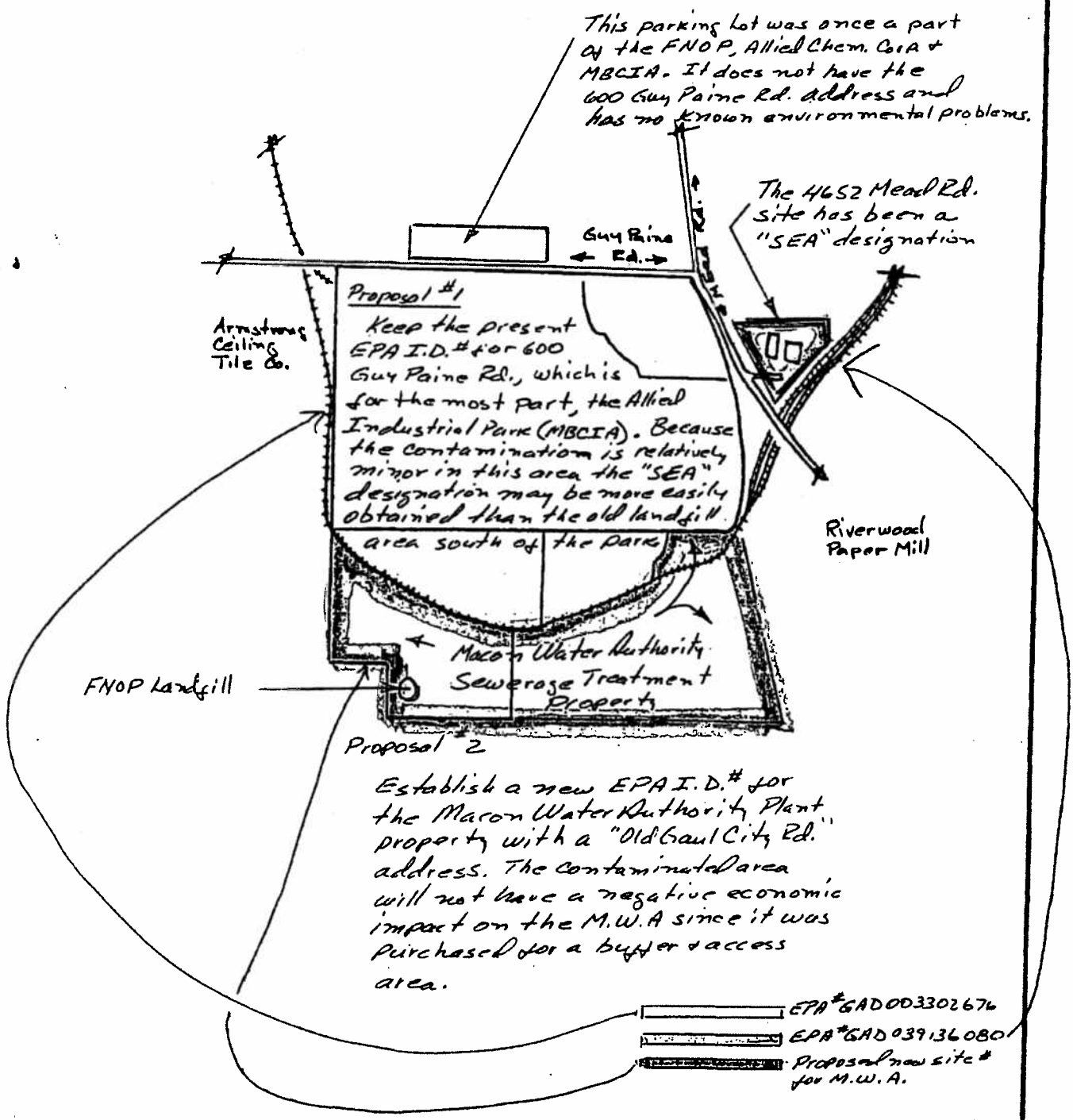


Allied Industrial Park

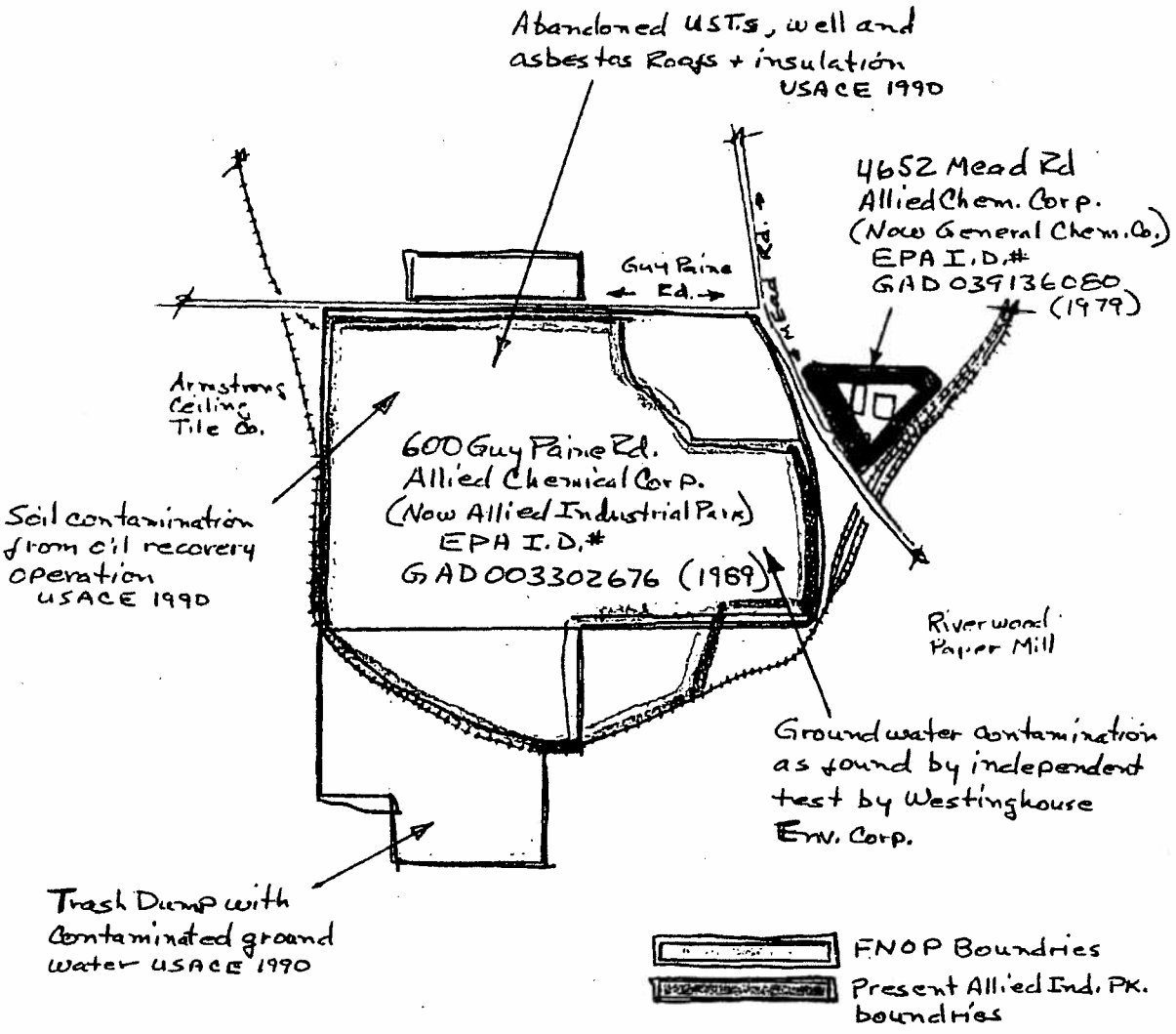
As of Jan. 1994



Allied Industrial Park /
Macon Bibb County Industrial Auth
As purchased from
Allied Chem. Corp. 1981



Proposed EPA Site Identification for the FNOP, Allied Chem. + MBCIA Property



Environmental Concerns within the boundries of the Former Naval Ordnance Plant

PRELIMINARY ASSESSMENT

FORMER MACON NAVAL ORDNANCE PLANT
A.K.A.
Allied Chemical Corporation
GAD 003302676

600 GUY PAINE ROAD
MACON, BIBB COUNTY, GEORGIA

PREPARED BY:

MERRILL L. MEEK
ASSOCIATE ENVIRONMENTAL SPECIALIST
GEORGIA ENVIRONMENTALM PROTECTION DIVISION

REVIEWED BY:

TIM CASH
UNIT COORDINATOR
GEORGIA ENVIRONMENTAL PROTECTION DIVISION
HAZARDOUS WASTE MANAGEMENT BRANCH

APPENDIX C

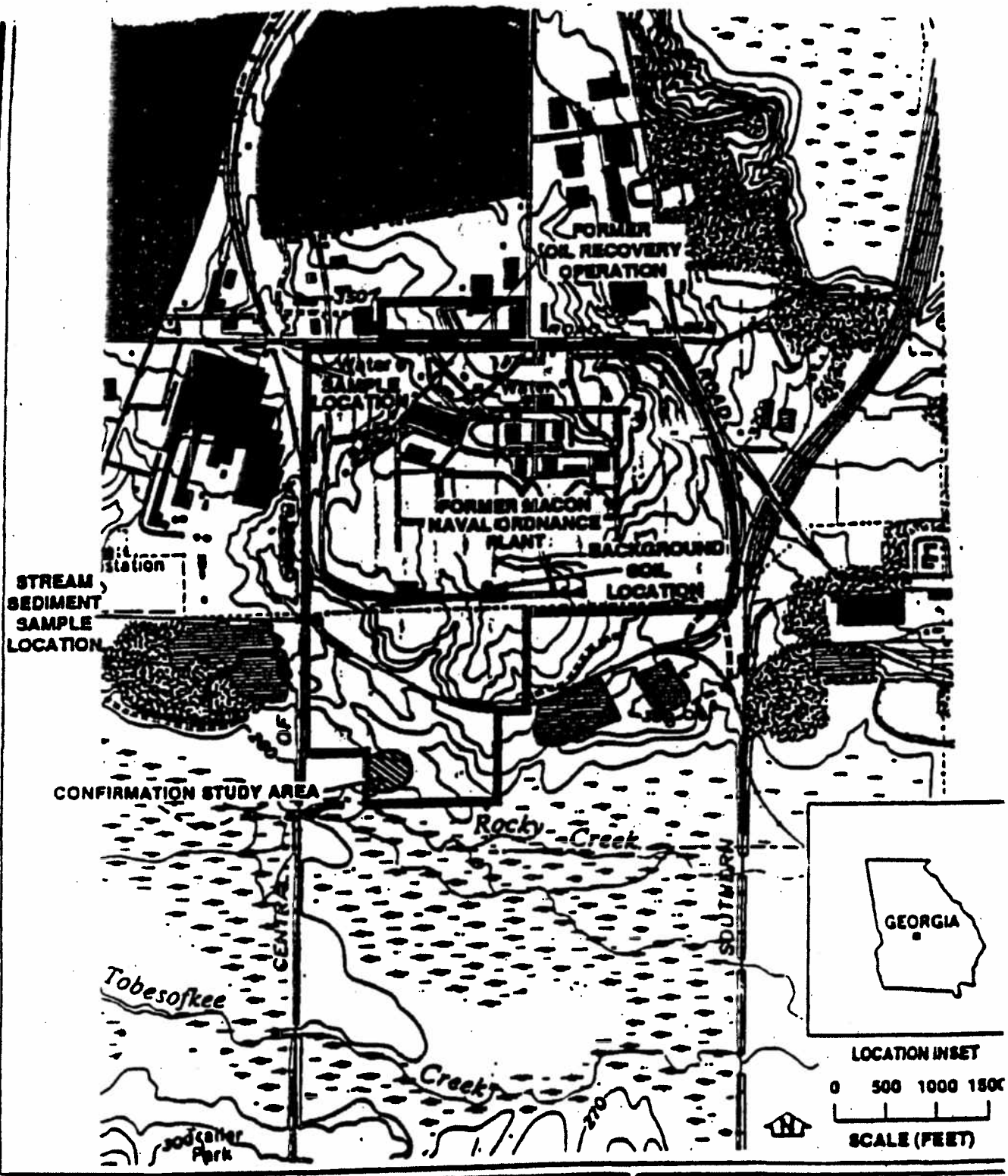


FIGURE A

CORPS OF ENGINEERS
MOBILE DISTRICT

Former Macon Naval Ordnance Plant

Preliminary Assessment
Former Macon Naval Ordnance Plant
AKA
Allied Chemical Corporation
GAD 003302676
600 Guy Paine Road
Macon, Bibb County, Georgia

1.0 INTRODUCTION

Under authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), and authorization by the Environmental Protection Agency to the state of Georgia, the Hazardous Waste Management Branch of the Environmental Protection Division of the Department of Natural Resources has conducted a Preliminary Assessment (PA) of the Former Macon Naval Ordnance Plant (FMNOP) in Macon, Bibb County, Georgia. The purpose of the assessment was to collect information concerning conditions at the site sufficient to assess the threats to human health and the environment, and to determine the need for additional investigation under CERCLA, SARA or other action. The scope of the investigation included a review of available records and documents, a comprehensive target survey, site reconnaissance and conversations with various individuals.

2.0 SITE DESCRIPTION, OPERATIONAL HISTORY AND WASTE CHARACTERISTICS

2.1 LOCATION

The Former Macon Naval Ordnance Plant (FMNOP) in Macon, Bibb County, Georgia is located at 600 Guy Paine Road. The geographical coordinates are 32° 46′ 30" N. latitude and 83° 38′ 46" W. longitude (Ref. 1). The site is shown on Figure A. The entire area comprises approximately 433.25 acres. Macon, Georgia is characterized as having a humid but temperate climate. The daily maximum average temperature is 76.5 degrees F. The daily minimum average temperature is 52.9 degrees F. The average rainfall is 44.89 inches per year with the greatest amount of precipitation occurring in March. The average prevailing windspeed is 7.6 miles per hour, with an average direction of WNW (Ref. 2).

2.2 SITE DESCRIPTION

The FMNOP occupies approximately 433.25 acres and is located in an industrialized area in the southern edge of Macon and Bibb County. To the south of the property is the floodplain of Rocky Creek. To the north of the property are a few light industrial facilities. On the north-

eastern portion of the site , the city operates a recreational facility including two ball fields and a swimming pool. Macon Kraft Company and a sewage treatment facility are located east of the site. To the west of the site is Armstrong Cork Company (Armstrong Cork World Industries).

There are many buildings located on the site, including warehouses, former military housing, maintenance shops and office space. Current use includes light industrial, maintenance facilities and office space. Buildings that originally stored explosives have been demolished, although one still remains on the northeast side of the site.

Records and site reconnaissance indicate several possible sources of contamination. These possible sources are summarized in TABLE 1.

2.3 OPERATIONAL HISTORY

In 1941, the site was acquired by the Department of Defense (DOD). It was operated by the Navy as the Macon Naval Ordnance Plant. During this period, the site was used for the manufacture of ordnance and explosives. In 1965, the DOD sold the site to Maxon Electronics Corporation. Maxon also manufactured ordnance at the site. In 1973, the site was sold to Allied Chemical Corporation. Allied manufactured seatbelt components at the site until 1981, when they sold the site to its current owners, Macon-Bibb County Industrial Authority. The site is currently known as the Macon-Bibb County Allied Industrial Park (Ref. 3).

2.4 WASTE CHARACTERISTICS

Two firms have conducted sampling at FMNOP. The first sampling effort was completed by Environmental Science and Engineering, Inc. (ESE) in September 1990. Their study was completed as part of the Defense Environmental Restoration Program (DERP). The results of their analyses are presented on TABLES 2, 3, and 4 (Ref. 3).

The second effort was completed by Westinghouse Environmental and Geotechnical Services, Inc. in May 1991. The results of their data are presented in TABLE 5 (Ref. 4).

A summary of the probable substances of concern is presented in TABLE 6.

3.0 GROUNDWATER PATHWAY

3.1 HYDROGEOLOGICAL SETTING

The Former Macon Naval Ordnance Plant is located on the very southern edge of the city of Macon. This area lies within the 20-50 mile zone of the cretaceous sands and gravel, forming a wedge of sediments known as the Tuscaloosa Formation, characterized by light-colored sand, sandy clay and lenticular masses of clay. Approximately 500 feet below surface level is the contact between the Tuscaloosa and the underlying Paleozoic and older crystalline rocks. These Cretaceous deposits form the principle groundwater aquifer for the Macon area. The depth of the shallowest surficial aquifer in the area is 5-22 feet-bls on the site. Area wells extend to depths of approximately 260 feet bls. (Ref. 2).

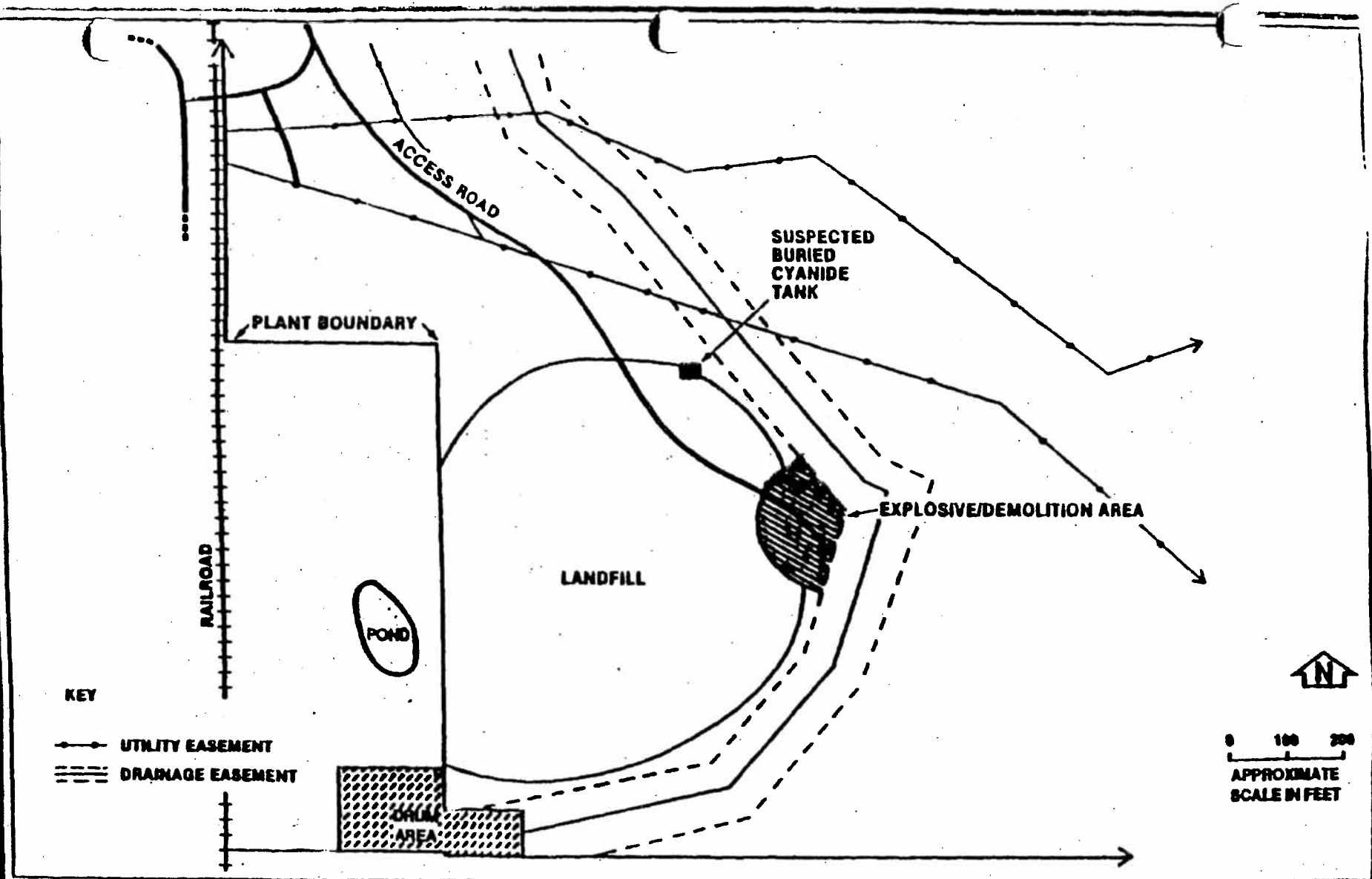


FIGURE B

CORPS OF ENGINEERS
MOBILE DISTRICT

Former Macon Naval Ordnance Plant

TABLE 2
GROUNDWATER DATA

Compound	Sample Identification MW-1	MW-2	MW-3	MW-4	MW-5	MW-3-DP	MW-EB	MW-TB	SD-TB	Water Quality Criterion	Regulatic
Cyanide (mg/L)	--	0.133	0.005	--	--	--	--	NRQ	NRQ	0.0035	GA
Nitrogen NO_2+NO_3 (mg/L as N)	5.45	0.151	0.040	--	--	0.073	0.021	NRQ	NRQ	10	MCL
Arsenic, Total (mg/L)	--	0.0032	0.0029	--	--	--	--	NRQ	NRQ	0.05	MCL
Barium, Total (mg/L)	0.0507	0.120	0.0556	0.0418	0.109	0.0569	0.0015	NRQ	NRQ	1.0	MCL
Chromium, Total (mg/L)	0.0140	0.0259	0.0181	0.0091	--	0.0118	--	NRQ	NRQ	0.05	MCL
Iron, Total (mg/L)	4.42	19.0	5.91	19.2	17.3	6.04	0.0124	NRQ	NRQ	0.3	MCL
Manganese, Total (mg/L)	0.428	0.590	0.0970	0.248	0.530	0.100	--	NRQ	NRQ	0.05	MCL
Selenium, Total (mg/L)	--	--	0.0023	--	--	--	--	NRQ	NRQ	0.01	MCL
Sodium, Total (mg/L)	20.6	28.7	13.6	8.12	9.30	14.3	0.169	NRQ	NRQ	20	GA Recom
PETN (µg/L)	68.8	--	--	--	--	33.3	--	NRQ	NRQ	NC	--
1,3-Dinitrobenzene (µg/L)	--	--	1.18	--	--	1.23	--	NRQ	NRQ	NC	--
2,4-Dinitrotoluene (µg/L)	--	--	1.83	--	--	1.68	--	NRQ	NRQ	1.1	Rosenblatt
Trichloroethene (µg/L)	--	7,000	3,800	110	19	3,900	--	--	--	5	MCL
Vinyl Chloride (µg/L)	--	--	--	170	--	--	--	--	--	2	MCL
Bis(2-Ethylhexyl) Phthalate (µg/L)	1.6	1.7	6.4	2.4	1.2	3.0	1.2	NRQ	NRQ	10,000	WQC

Note:
- GA = Georgia state standard described in EPA (1988).
- GA Recom = recommended Georgia standard--unenforceable (Personal Communication, Fred Lehman).
- MCL = maximum contaminant level specified in the National Primary Drinking Water Regulations, 40 CFR 141.11 (July 1, 1986) and the National Secondary Drinking Water Regulations, 40 CFR 143.3 (July 1, 1986).
- mg/L = milligrams per liter.
- NRQ = not required.
- PETN = pentaerythritol tetranitrate.
- Rosenblatt = criteria suggested by Rosenblatt (1981) for the permissible concentration level for the contaminant in drinking water.
- µg/L = micrograms per liter.
- WQC = suggested ambient water quality criteria for the protection of human health from the toxic properties or carcinogenic effects of the compound; criteria associated with cancer risk levels (CRLs) of 1×10^{-6} are reported where available; these criteria are summarized in the document Quality Criteria for Water 1986, EPA, May 1, 1986, Washington, DC; criteria were previously announced in 45 FR 79318 (November 28, 1984), 49 FR 5831 (February 15, 1984), and 50 FR 30784 (July 29, 1984).
- -- = not detected at method detection limit.

TABLE 1

POSSIBLE SOURCES OF CONTAMINATION
FORMER MACON NAVAL ORDNANCE PLANT

STRUCTURE	SIZE	LOCATION
UST		
Mineral Spirits Tank	4,000 gal	Building No. 157
Cutting Oil Tank	12,000 gal	Building No. 158
Kerosene Tank	250 gal	Building No. 183
Diesel Fuel Tank	560 gal	Building No. 184
Gasoline Tank and Pump	2,000 gal	Building No. 185
AST		
Oil Storage Tank	15,000 gal	Building No. 4
Oil Storage Tank	15,000 gal	Building No. 104
LANDFILL	15 ACRES	SE of plant
EXPLOSIVES DEMOLITION AREA	Approx. 1 acre	SE of plant
CYANIDE CONTAMINATED BOX	Approx. 5,000 gal	NE corner of landfill
DRUM STORAGE AREA	500 drums	SW of landfill
POND	Approx. 1 acre	W of landfill

TABLE 4

Table 4-2. Summary of Results of Soil Sample Analyses--First Field Effort

Compound*	Sample Identification					
	SO-1	SO-2	SO-3	SO-4	SO-5	SO-3-DP
Moisture (% wet wt.)	9.3	14.2	11.6	44.3	52.6	13.4
Arsenic	0.650	1.55	0.374	0.781	4.83	0.502
Barium	6.92	11.4	8.71	196	70.5	7.26
Chromium	7.02	8.87	5.82	22.1	29.6	3.99
Lead	--	5.00	--	41.8	39.3	--
Anthracene	--	--	--	--	0.32	--
Benzo(a)Anthracene	--	--	--	--	1.4	--
Benzo(b)Fluoranthene	--	--	--	--	0.92	--
Benzo(k)Fluoranthene	--	--	--	--	0.67	--
Benzo(a)Pyrene	--	--	--	--	0.69	--
Benzo(g,h,i)Perylene	--	--	--	1.9	0.72	--
Chrysene	--	--	--	--	0.95	--
Fluoranthene	--	--	--	--	2.1	--
Indeno(1,2,3-cd)Pyrene	--	--	--	--	0.75	--
Phenanthrene	--	--	--	--	1.0	--
Pyrene	--	--	--	--	1.8	--
Nitrogen, NO_2+NO_3, Sediment (µg/g-dry)	4.3	--	--	196	--	0.71
Hydrocarbons, Petroleum (µg/g-dry)	--	--	--	1,020	207	--

Note: µg/g-dry = micrograms per gram, dry weight.
-- = not selected at method detection limit.

* Units are in milligrams per kilogram, dry weight (mg/kg-dry) unless otherwise noted.

Source: ESE, 1990.

TABLE 3

Table 4-3. Sumary of Results of Soil Sample Analyses--Second Field Effort

Compound*	Sample Identification			
	SD-1	SD-2	SD-DUP#2	BKGSOIL
Moisture (% wet wt.)	18.0	9.4	13.1	13.1
Arsenic	0.318	1.87	1.84	1.98
Barium	11.2	30.4	27.0	26.4
Cadmium	0.564	0.657	0.766	--
Chromium	4.40	12.9	13.6	21.0
Lead	5.76	22.6	26.9	5.32
PETN	--	4.92	6.10	--
Nitrogen, NO_2 and NO_3 (μg/g-dry)	4.18	--	--	1.78
Hydrocarbons, Petroleum (μg/g-dry)	--	12600	12200	--

Note: μg/g-dry = micrograms per gram, dry weight.
-- = not selected at method detection limit.

* Units are in milligrams per kilogram, dry weight (mg/kg-dry) unless otherwise noted.

Source: ESE, 1990.

TABLE 6

PROBABLE SUBSTANCES OF CONCERN

FORMER MACON NAVAL ORDNANCE PLANT

Lead	**Trichlorethane**
Iron	**2,4 DNT**
Barium	**1,3 DNB**
Arsenic	**PETN**
Cyanide	**PAH's**

TABLE 5
WESTINGHOUSE DATA

SUMMARY OF TEST RESULTS

The following individual test results exceed the maximum contaminant levels of the Primary or Secondary Drinking Water Regulations:

	Test Results				Water Quality	
Compound	MW-1	MW-2	MW-3	MW-4	Criteria	Regulation
Barium	-	-	1.46ppm	-	1.0ppm	MCL
Chromium	7.18ppm	0.60ppm	0.85ppm	0.09ppm	0.05ppm	MCL
Lead	0.31ppm	-	0.82ppm	-	0.05ppm	MCL
Iron	106ppm	56.7ppm	104ppm	47.2ppm	0.3ppm	MCL*
Manganese	1.31ppm	0.38ppm	3.34ppm	0.55ppm	0.05ppm	MCL*
Aluminum	179ppm	65.1ppm	737ppm	62.5ppm	0.05ppb	MCL**
Trichloroethene	-	22ppb	-	62ppb	5ppb	MCL

MCL = Maximum contaminant level specified in the National Primary Drinking Water Regulations, 40 CFR 141.11 (July 1, 1986) and the National Secondary Drinking Water Regulations, 40 CFR 143.3 (July 1, 1986).

ppm = parts per million or milligrams per liter
ppb = parts per billion or micrograms per liter
MCL* = current secondary maximum contaminant level
MCL** = proposed secondary maximum contaminant level

3.2 GROUNDWATER TARGETS

Residences in the immediate area of FMNOP obtain their potable water from the City of Macon municipal system. This municipal system draws water from an intake on the Ocmulgee River. This intake is located approximately ten miles to the north of the site. There are no known private wells within four miles of the site.

There are industrial wells within approximately one mile of the site. All but one of these wells are used to obtain industrial process water. Macon Kraft Company operates one well to obtain potable water. This well is approximately 260 feet deep and is 2,800 feet from the site. There are no known complaints concerning the quality of the water (Ref. 5).

3.3 GROUNDWATER CONCLUSIONS

Based on observations and a review of the records, a release to groundwater is suspected. This observation is substantiated by studies conducted by ESE, Inc. and Westinghouse. However, the immediate threat to human health and the environment can not be confirmed since one well was located in the area of the site.

4.0 SURFACE WATER PATHWAY

4.1 HYDROLOGIC SETTING

The Former Macon Naval Ordnance Plant is on a small knoll, and drainage from the site generally occurs to the south and southeast. Drainage for the area southern portion of the site occurs through a small drainage easement which empties into Rocky Creek, a tributary of the Ocmulgee River. The confluence of the Ocmulgee River and Rocky Creek is approximately 4 miles southeast of the site (Ref. 3). The southern tip of the site is located in the 100-year floodplain (Ref. 6) and marshy wetlands were noted in this area during on-site reconnaissance.

4.2 SURFACE WATER TARGETS

There are no drinking water intakes on the surface water pathway for a distance of 15 miles downstream of the facility on either Rocky Creek or the Ocmulgee River.

4.3 SURFACE WATER CONCLUSIONS

The surface water pathway is of concern at the Former Macon Naval Ordnance Plant. However, there is no evidence to show the migration of contamination to off-site sediments. In addition, there are no intakes on surface waters within 15 miles downstream.

TABLE 7

THREATENED AND ENDANGERED SPECIES

BIBB COUNTY, GEORGIA

SPECIES	GENUS	STATUS
Red Cockaded Woodpecker	Picioides borealis	Endangered
Southern Bald Eagle	Halialetus leucocephalus leucocephalus	Endangered
Fly Catcher	Sarracenia flava	Threatened
Sweet Pitcher Plant	Sarracenia rubra	Endangered

REFERENCES

1. US Geological Survey, 7.5 Minute Series Topographical Maps of Georgia: Warner Robins NE (PR 1985); Warner Robins NW (PR1984); Macon East (PR 1985); Macon West (PR 1985).

2. National Weather Service. Local Climatic Data for Macon, Georgia. Information compiled as long-term averages.

3. Engineering Report: Confirmation Study of the Former Macon Naval Ordnance Plant, Macon, Bibb County, Georgia. Prepared for the US Army Corps of Engineers, Mobile, Alabama. Prepared by Environmental Science and Engineering, Inc.: Contract No. DACA01-88-10-0027, September 1990.

4. Modified Phase I Preliminary Environmental Evaluation, Allied Industrial Park ± 28 Acre Site, Macon, Georgia. Prepared by Westinghouse Environmental and Geotechnical Services, Inc. Job No. 1108-91-036A, May 1991.

5. Mr. Jimmy Taylor, Environmental Health Specialist IV, General Environmental Section of the Macon-Bibb County Health Department. February 10, 1992.

6. Ms. Alexis Harris, US Geologic Survey. February 2, 1992.

7. Georgia Department of Natural Resources, Game and Fish Division/Freshwater Wetland and Heritage Inventory Program. January 18, 1991.

5.0 SOIL EXPOSURE AND AIR PATHWAY

5.1 PHYSICAL CONDITIONS

A review of available records indicates that approximately 5,000 people live within 4 miles of the site. The population within one mile of the site is approximately 300. The closest residence is less than 1/2 mile of the site (Ref. 2).

The land in the vicinity of FMNOP is light to heavy industrial and commercial. The ranges of some endangered and/or threatened species occur in South Bibb County. These are listed in TABLE 7. However, it has not been confirmed that any of these species are known to occur within 4 miles of the site (Ref. 8).

Access is totally unrestricted at the site and evidence of human intrusion into areas of possible contamination was noticed during the site visit.

5.2 SOIL AND AIR PATHWAY CONCLUSIONS

The air pathway is not of concern at FMNOP given that most or all of the possible sources of contamination are within the soil and buried. However, the soil pathway is of concern. This is evidenced by previous sampling at the site. These data suggest ordnance, hydrocarbons and metals in the soils at FMNOP. Since access to the site is not restricted through barriers, there is the possibility of contact with possible sources of contamination. Although this site is
active, workers are generally not in close proximity of these possible sources of contamination.

6.0 SUMMARY AND CONCLUSIONS

The soil, surface water, and groundwater pathways are all of primary concern at the Former Macon Naval Ordnance Plant. Previous sampling shows contamination of both the soils and groundwater. The surface water pathway is of concern due to the location of the waste areas in the 100-year floodplain and the proximity to a sensitive environment (wetlands).

Based on the results of this Preliminary Assessment and the PA Score computer program, this site receives a score of [redacted]. Given this score, the Former Macon Naval Ordnance Plant is recommended as a candidate for a Site Inspection.

31.0